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STEEL CONSTRUCTION

Pittsburgh

THE UNITED GAS IMPROVEMENT COMPANY,

PHILADELPHIA.

BUILDERS OF

THE STANDARD DOUBLE SUPERHEATER

LOWE WATER GAS APPARATUS.

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OF

AIR AND STEAM SUPPLY

(PATENTED),

AFFORDING { PERFECT CONTROL OF GENERATOR FIRE CONDITIONS.

PRODUCING { UNIFORM RESULTS. HIGHEST EFFICIENCIES.

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Applications of Centrifugal Machinery for Boosting and Exhausting Gas.[1]

[Prepared by MR. E. A. HULTS, for Tenth Meeting, Illinois Gas Association.]

The development of the centrifugal compressor is closely associated with that of the steam turbine. The centrifugal compressor to-day stands in the same relation to other compressors as the steam turbine stood 15 years ago to the reciprocating engine, or as the centrifugal pump 5 years ago to other pumping apparatus.

Some 8 or 10 years ago experiments were started at Lynn, Mass., the immediate object being to produce an efficient, steady and reliable centrifugal compressor.

Among the promising devices developed was an experimental, single-stage water pump, capable of delivering 100 gallons per minute at a head of 1,200 feet. For commercial reasons construction of centrifugal pumps was not continued, but it was felt there was a demand for a better machine for compressing air and gas, and its development has been actively followed.

In order to understand the various applications of centrifugal machines it will be fitting first to explain how the machines are constructed, and then their operating characteristics.

The single stage compressor consists of a rotating impeller mounted on the shaft of the driver, and surrounded at its periphery by stationary discharge vanes; the impeller and discharge vanes inclosed in a circular casing having intake and discharge. The shaft is supported by self-aligning, automatically oiled bearings, and these are the only rubbing or wearing parts. The frame of the driver is attached to the compressor-case by a suitable yoke, and the set is shipped as a completely assembled unit ready to place on foundations.

The rotating elements of the compressor and driver are thoroughly balanced, and since every point on the periphery of the impeller does an equal amount of work under all load conditions, there is practically no wear on the bearings. The air or gas enters centrally on both sides of the impeller, thus there is no end thrust to compensate. This compressor is the only type built with this double-flow feature, which distinguishes it from European designs. Figs. 1 and 2 illustrate the extreme simplicity of the single stage machine.

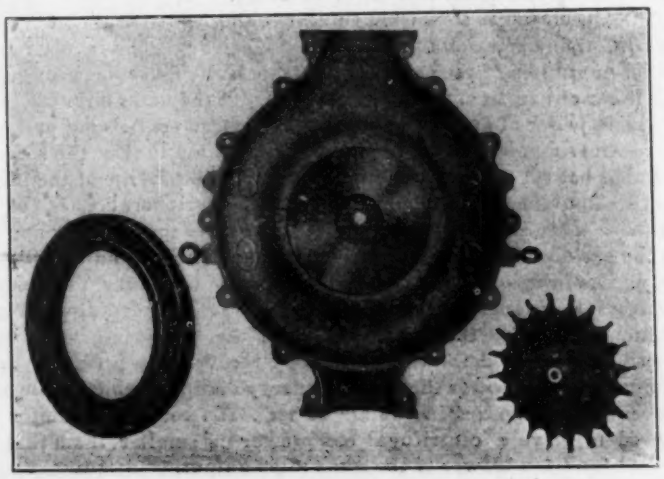


Fig. 1.—Impeller, Discharge, Vanes, and Half Casing of Single Stage Compressor.

The multi-stage compressor is simply 2 or more single-stage impellers and discharge vanes in series, separated by diaphgrams, which direct the air or gas from one stage to the next. Water cooling compartments are provided in the diaphgrams for cooling the air or gas. All the impellers are mounted on the one shaft, direct connected to the driver, and casing, diaphgrams and discharge vanes are all split horizontally so that the machine is readily assembled and accessible for repairs.

One of the striking features of these compressor units is high efficiency, which they are capable of maintaining for years without renewals, due to the fact that they are capable of recovering, in the form of pressure, nearly all the velocity-energy imparted to the air by the high peripheral speed of the impeller, instead of dissipating the energy in heat. Owing to the absence of valves and rubbing surfaces there is no possibility of leakage, with the subsequent decrease of efficiency which characterizes all forms of positive blowers. Other advantages are small size for a given output; high speed, permitting direct-connected, high-speed drivers; the absence of belting

1. Slightly abridged.—EDS.

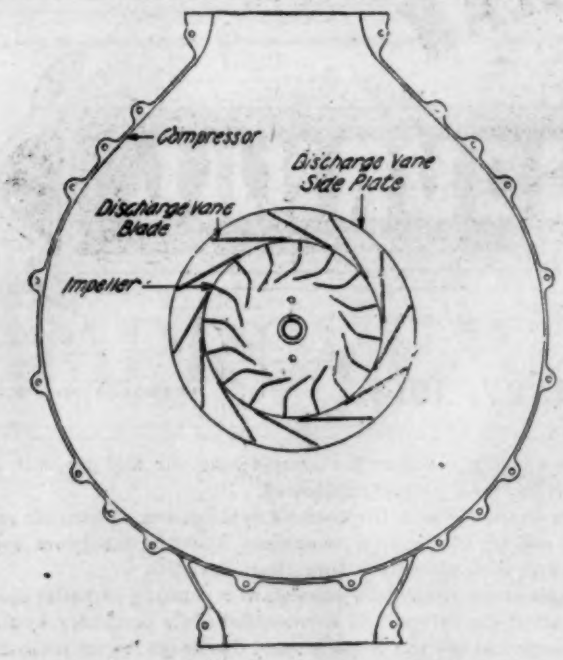


Fig. 2.—Section Through Single Stage Compressor.

or gears; lower cost of up keep; absence of noise and vibration; greater durability; extreme simplicity. The successful centrifugal compressor necessitates a thoroughly reliable high speed driver. Standard steam turbines have been used in many cases; and where direct-current motors are used as drivers, the equivalent generator already developed for turbo-generator sets may be used as a motor. A complete standardized line of single stage machines is now on the market for air pressure, from ¼ pound to 4 pounds per square inch, and volumes from 750 cubic feet to 12,000 cubic feet per minute. Many special machines for higher pressures and larger volumes have been built, and almost any requirement for handling air or gas can be accomplished with this type of machine.

The fan blower is somewhat similar to the centrifugal compressor, but differs in operation and is lower in efficiency. The revolving impeller or runner of the centrifugal compressor, takes in air or gas at the inner circumference and discharges it at the outer circumference of the impeller at an increased pressure, termed centrifugal pressure, or pressure due to centrifugal force. In addition to this, the rotating element has set the gas in motion, and at the discharge of the impeller, it is moving at the same velocity as the peripheral speed of the runner. It is evident that the input in work to the impeller appears in the gas discharged in two forms, pressure energy and velocity energy. The function of the discharged vanes is to convert the velocity energy into pressure energy, and they are so designed that the gas, in flowing through the passages between the vanes, is gradually reduced in speed, and the velocity energy recovered in pressure. In an ordinary fan or blower the velocity energy dissipates chiefly into eddy currents, and appears in the air as heat. Therefore, the motor required to drive a centrifugal compressor is smaller than that required for a fan blower of the same rated output.

In the displacement, or positive pressure, type of blower the gas is pocketed on the intake side and carried in these pockets to the discharge side. If there is no resistance or pressure at the discharge the gas is simply moved from inlet to outlet, but if there is pressure at the discharge, the gas delivered will be raised to that pressure. In other words, these machines displace, at each revolution, a certain amount of gas. In displacement machines the clearance between rotating and stationary parts must necessarily be very small to prevent serious leakage, and it is extremely difficult to correctly maintain this clearance; in practice, clearance adjustments are not made frequently enough, introducing a large slippage and loss of efficiency, and when adjustments are made, serious losses in energy occur, due to heavy friction from close clearances. The inherent action of the displacement blower is such as to increase wear, since the gas is delivered in a rapid series of puffs or pulsations. A new displacement machine usually has a slippage of 10 to 15 per cent., that is, the actual gas passed will be 85 to 90 per cent. of the nominal displacement volume rating. When they have been in service some time, the slippage factor materially increases and in some cases the actual gas passed is as low as 50 per cent. of the nominal displacement.

If displacement blowers are required to give constant pressure and variable volume, they must be run at variable speeds, necessitating drivers with a complicated method of speed control, if reasonable efficiency is to be secured. Sometimes they are operated at constant speed with automatic by-pass valves so that, when a reduced quantity of air is handled, the blower continues to compress its rated volume and the surplus passes back into the intake. On the other hand a centrifugal compressor inherently maintains constant pressure at a given speed, and the volume delivered depends only on the demand, within the limits of the capacity of the machine.

Once properly installed, the only attention required by the centrifugal compressor is to maintain a plentiful supply of oil in the bearings, and this lubrication is automatic and the oil used over repeatedly, and in comparison with other forms of blowers the reduction in oil expense is of material importance.

Owing to the service which a gas company has to give, gas engineers have been very conservative about making changes and installing new types of machinery. But, since centrifugal compressors are no longer an experiment, there need be no hesitancy about applying them to gas service.

The operating characteristics of the centrifugal compressor have a distinct bearing on the application of these machines for handling air and gas in gas plants. The differential between the intake and discharge pressure depends, as in centrifugal pumps, on the peripheral velocity or rim speed of the impeller. Fig. 3 shows the inherent

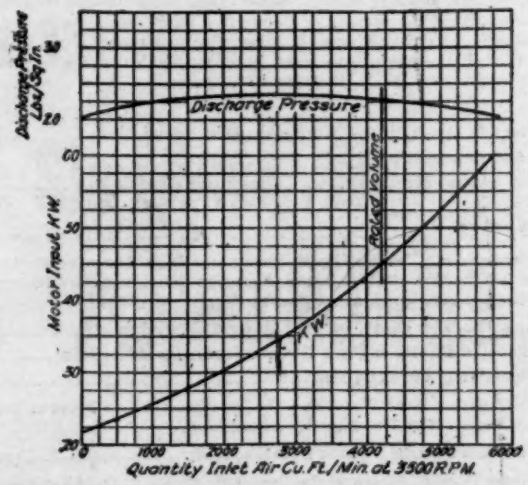


Fig. 3.—Quantity Curves—Pressure and Power at 30-inch Barometer and 60° F. Atmospheric Temperature.

characteristics of a compressor running at constant speed and are those of the machine shown in Fig. 4. The pressure is practically

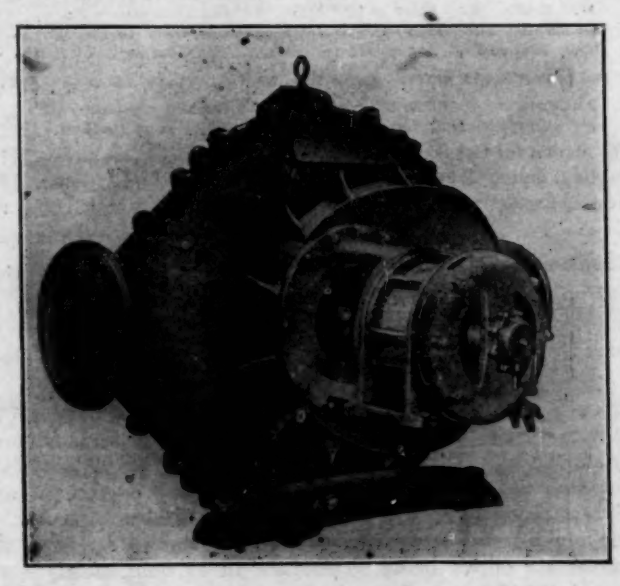


Fig. 4.—Centrifugal Compressor Driven by Induction Motor.

constant over a wide range of load and free from pulsations. By controlling the speed of a direct current motor or steam turbine driven set, the pressure can easily be changed and will vary as the square of the speed.

The volume delivered is not a direct function of the speed, but of the resistance of the line from or into which the machine is working. The volume handled will automatically vary with the load changes, thus, any centrifugal compressor will deliver its full rated load if it is being used by the consuming apparatus, or if only half rated load load is being consumed, the machine will automatically deliver only that quantity.

Referring again to Fig. 3, it will be seen that the energy input varies almost directly with the volume output. This, with the high and lasting efficiency, makes the machine especially economical.

There are several physical conditions which change the characteristics of a centrifugal compressor, and for this reason they are given a sea level air rating at standard conditions, *i. e.*, barometric pressure of 14.7 lbs., absolute and inlet temperature 6° F.; ratings for all other conditions being calculated from this base. If the machine is to operate above sea level, the available pressure is reduced in proportion of the actual barometric pressure to 14.7 pounds absolute (30 inch mercury). (Fig. 5).

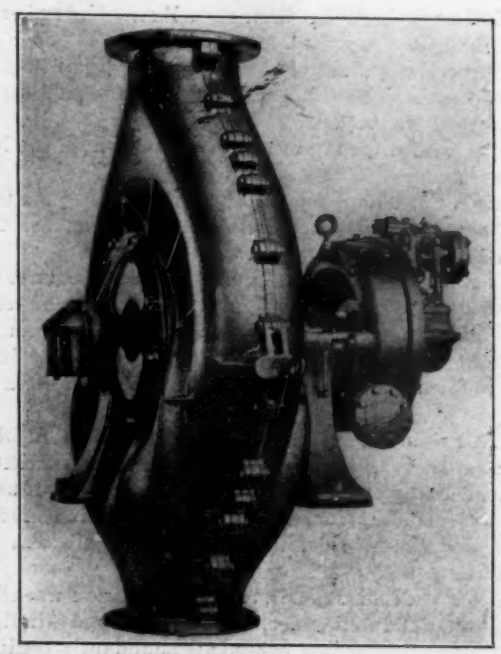


Fig. 5.—Centrifugal Compressor Driven by 50 H. P. Curtis Turbine.

If the inlet temperature "T" differs from 60° F., the actual pressure will be the rated presure multiplied by

$$\frac{(460 + 60)}{460 \times T}$$

The peripheral velocity of the gas emitted from the impeller will change with the density of the gas. To find the pressure a machine will give when handling a gas other than air, it is necessary to multiply the air pressure rating of the machine by the specific gravity of the gas (specific gravity of air as unity).

Standard volumes of gases must be corrected to intake conditions for changes in temperature, pressure and moisture, using usual correction factors.

The inherent characteristics of the centrifugal compressor can be improved or changed to those directly opposite by applying different types of governors. If it is desired to maintain either a constant pressure or suction and a variable volume, a governor similar to that in Fig. 6 is used, consisting of a Huntoon control connected by suitable levers to the governing mechanism of the driver. In this arrangement the weight (4) is adjusted for the desired suction and balances the suction on the cup (1), and pipe (35) is connected to the suction line. If for any reason the suction tends to change, the cup (1) is moved up or down, and, in conjunction with the governing mechanism, through the levers, operates the balanced pilot piston (31), which in turn moves the valve stem (29), opening or closing the valves (21), (25), (26) and (27), the amount necessary to change the speed of the driver to overcome the change. Ball-bearing joints are used wherever possible to reduce friction, and the balance weight (20) prevents too violent oscillations. The emergency speed governor lever (13) maintains a fixed position at all speeds up to maximum for safe operation, at which time the governor acts and shuts off the steam to the turbine.

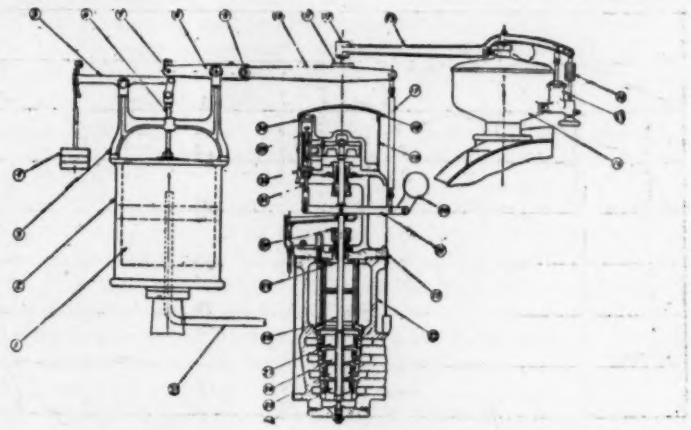
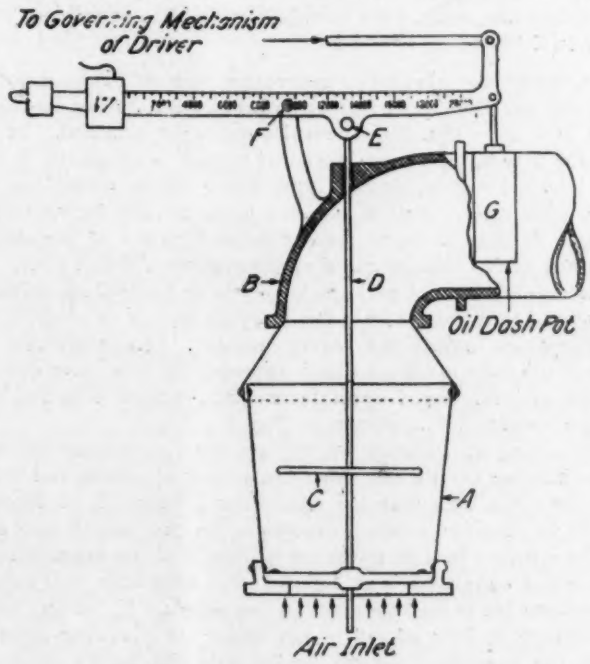


Fig. 6.—Arrangement of Constant Suction Governor

If a constant volume at variable pressures is desired, a constant volume governor, such as shown in Fig. 7, is supplied. The weight,



Constant Volume Governor.

Fig. 7.

W, set for desired volume, balances the upward pressure on disk *C*, due to the air passing through *A*. If the pressure exerted by the blower cannot force through the required volume, *C* drops, because of the reduced pressure upon it, and through the governing mechanism of the driver, changes the speed until a pressure is exerted by the compressor, capable of delivering the desired volume, at which time the disk resumes a position of equilibrium. The oil dash-pot *G*, is to dampen violent occillations.

The speed regulation of the steam turbine is the easiest and most accurate which the present stage of the art has yet produced, and this, together with the fact that fairly large variations of pressure require comparitively small variations in speed, make the turbine driven centrifugal compressor the closest and most accurate known means of pressure or volume regulation.

Fig. 8 shows the character istic air pressure and volume curves for a water gas generator, the pressure practically constant, the volume variable. The blasting time is about 3 minutes and the running time 4. For this cycle and characteristics a standard compressor, set similarly to that shown in Fig. 4, can be used. The blast is generally controlled by a blast gate at the discharge of the compressor, but sometimes with turbine driven sets the driver is started and stopped for each operation, although the energy required to overcome the inertia of the rotating parts and to bring the set up to full speed, may be in excess of that required to run continuously with the blast gate closed. With a centrifugal compressor set, operating under conditions outlined in Fig. 8, and the blast controlled by a gate, the approximate K. W. input (including all losses in both compressor and driver), for a motor driven set will be about as follows:

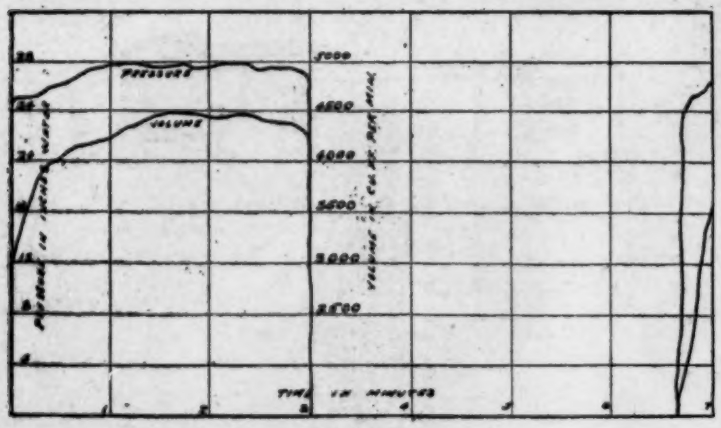


Fig. 8.

Blast gate open full, capacity 4,500 cubic feet per minute at 1 pound gauge pressure, equals 26.8 K.W.

Blast gate shut, no air delivered to generator, equals 14 K.W.

The approximate input per complete cycle of blast and run will be about 2.24 K.W.H., or 2.86-H.P.H.

If the compressor blows two generators, one set blasting with the other running, practically full load could be maintained on the compressor and more economical results would be obtained. In large water gas plants, where no electrical energy is available, it would pay to install a turbo-generator and motor driven centrifugal compressor, with special motors and automatic control for starting and stopping. Saving in steam costs of approximately 15 per cent. can be obtained by the application of an arrangement of this kind.

In the manufacture of coal gas in retorts or by-product coke ovens it is essential that the gas be taken away as rapidly as made, and the suction pressure maintained nearly constant. The centrifugal compressor is the only machine which successfully fills these qualifications, the maintaining of absolute constant suction obtained by the use of a constant suction governor (Fig. 6).

In explaining its operation we will assume a turbine driven centrifugal exhauster taking raw gas from a bank of retorts and delivering to the cleaning apparatus and relief holder. It is desired to maintain an absolute constant suction in the gas holder, and to this point the constant suction governor is piped and the operation of the governor and exhauster is as follows: The exhauster will automatically deliver gas at the rate made in the retorts. If, for any reason, the resistance to flow of gas in the coolers or cleaning apparatus changes, the suction in the gas header will also have a tendency to change, but the governor will immediately respond and speed up or slow down the driver the exact amount necessary to overcome the change in resistance, and thus maintain constant suction within 1/10 inch water pressure. With these exhausters it is not necessary to maintain a hydraulic seal in the gas retort header, for, when recharging or other changes occur, the pressure in the header will be constant and free from pulsations, thus eliminating any possibility of taking air into the gas mains, or breaking the seals, if used. The centrifugal compressor also removes tar and foreign particles from the gas. While not built as tar extractors, we know that considerable tar is removed while the gas is passing through the machines. For this purpose they have sealed tar drains, with hand holes for inspection purposes, and water seals for preventing gas or air leaks.

Fig. 9 shows a characteristic distribution curve for 24 hours. The volume delivered varies through a very wide range, but the pressure at the station is fairly constant, another application where a constant pressure and variable volume machine is necessary. The economy of centrifugal compressor handling this type of a load is remarkable, the steam consumption being in direct proportion to the volume delivered. The pressure curve shows a maximum variation of 1½ pounds in 24 hours, and the speed of a centrifugal compressor would but have to be varied only 16 per cent. to take care of this change in pressure.

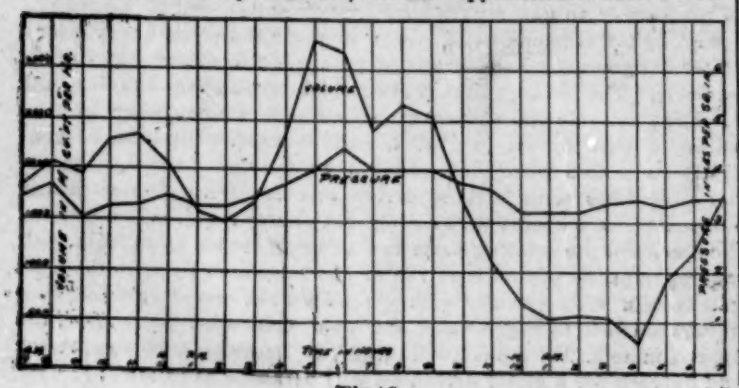


Fig. 9.

[Official Report.—Continued from Page 253.]

FORTY-FOURTH MEETING, NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

Second Day.—Morning Session.

President Hintze called for order at 10 A.M., and said the first business in order was the report.

Report from Committee on Memorial to John A. Coffin, which was read by Mr. Waldo A. Learned, as follows:

John A. Coffin was born in Nantucket, Mass., November 20, 1852, and died at Gloucester, April 26, 1913.

He was a direct descendant of Tristram Coffin, the first settler of the name, who came to New England in 1642, and was one of the 10 original owners of Nantucket.

Mr. Coffin succeeded his father as Superintendent of the Nantucket Gas Company, and was in its employ for 5 years.

In 1882 he went to Gloucester, as Superintendent of the Gloucester Gas Light Company; was elected its Treasurer, October, 1908; and retired from active business, January, 1911.

During his administration, the capital of the Gloucester Company increased from $60,000 to $150,000, and the gas sales increased from 8,000,000 to approximately 70,000,000 cubic feet per annum. His able management of the Company was attested by the large increase in the patrons, coupled with several substantial reductions in the price of gas.

He was past-President, the New England Association of Gas Engineers, and an active member of the American Gas Institute; was elected to membership of the Guild of Gas Managers, June 11, 1886, serving it as Treasurer, from March, 1882, to March, 1902, and as President, from March, 1905, to March, 1907. He was re-elected Treasurer, March, 1913.

In association with his friends, his conversation was illumed by alert observation, apt intelligence, and a keen and kindly humor. The frequent quotation of his comments abundantly testifies to the remembrance of their interest and wisdom. He was endowed with those qualities which inspire affection and esteem, and he will be deeply missed by his business and fraternal associates.

Waldo A. Learned, Wm. E. McKay, } Committee.

On motion of Mr. Barnum it was ordered that the report be spread upon the minutes, and that a copy thereof be sent to the family of deceased.

The President then asked if the

Report of Committee on Memorial to Rufus E. Holmes

was ready for consideration. Whereupon Mr. C. A. Learned read the following:

Mr. Rufus E. Holmes died May 5th, 1913. He was elected President of the Winsted (Conn.) Gas Company, January 12, 1887, and held that office until the day of his death.

He was the senior member of the banking house of Holmes & Gay, and was actively identified with many other local interests. A firm believer in the present and future of the gas industry, he was quick to recognize the desirability of combining gas and electric interests in small communities. He installed a small direct current lighting plant before the commercial adoption of alternating current.

He was a great lover of Nature, and, as a pastime, made the original surveys, afterward resulting in locating the Company's hydraulic plant at Robertsville.

At the time of his death he had partially worked out water power development at Sandy Brook and Pleasant Valley, to become part of the Gas Company's system. A firm believer also in water gas as an adjunct to coal gas, one of the first water gas plants was installed in Winsted under his supervision.

Mr. Holmes was elected to Associate Membership in 1889, and never missed a meeting of the New England Association during his membership.

J. Arnold Norcross, C. A. Learned, } Committee.

On motion of Mr. Nettleton the report was adopted and ordered placed on record; further, that a copy be sent to the family of deceased.

The President announced that in the interim of getting the apparatus ready for the lecture, it might be well to have a

A TRY AT THE QUESTION BOX.

The first question considered was,

"Is liquid purification feasible?"

Mr. Carroll Miller was invited to say something about the experiments at the South Station, Providence (R. I.) works in respect of liquid purification.

Mr. Miller—I hardly believe there is anything worth speaking of as to those experiments, so I will not take up your time with it. The only successful liquid purification that I know of is the Feld process, of which I think all these gentlemen know. It is being installed to a great extent in Europe. I was there examining the process at this time last year. So much has been written about it that I won't enlarge on the subject, except to say that I found it to be entirely successful.

The President—The next question referred to is something we always have with us:

"Causes of and remedies for naphthaline in water gas plants?"

I think enough members have had experience with napthaline in water gas plants who could say a little something in regard to it. Mr. Kennedy, would you care to speak regarding napthaline in water gas?

Mr. Kennedy—I don't think we have anything interesting in regard to water gas, but we have quite a bunch of it in coal gas.

The President—Would you care to say anything in regard to your previous experience in water gas plants as to naphthaline?

Mr. Kennedy—I don't know that we were ever specially troubled with it; in fact, the only real connection I have had with water gas operation was abroad. There we did not experience any naphthaline troubles with it; in fact, one of our great selling points was that we did not have any naphthaline. Since I came here I find a tendency to get a little bit at times, which I have never seen abroad, probably due to the conditions of operation. I don't think I could give you anything very useful on that point. I will say, since we have been running more coal gas and less water gas, we have felt quite severely the extra burden of naphthaline in our plant. I think that, up until last spring, the Cambridge plant was never seriously troubled, beyond the ordinary number of complaints which one usually gets at the change of the year, spring and autumn; but the spring and autumn of last year we had quite a deluge. We placed it very largely to having cut down, all through the summer, our water gas, from something like 30 to 35 per cent., to 12 and 15 per cent. When the autumn came we found quite a little naphthaline.

The President—Mr. Africa, would you care to say anything about naphthaline in water gas?

Mr. Africa—We have not had a great deal of trouble with naphthaline, but Philadelphia uses a naphthaline scrubber, using water gas tar to pump through this scrubber, which removes the naphthaline. With our combination plant of water gas and vertical retorts we have had no trouble with napthaline.

Mr. Kennedy—I should like to ask Mr. Africa if he will state in what position his water gas tar washer comes. We started the use of that last year, and it helped us quite a lot; but we use it after the ammonia scrubber. We could not very well connect up any other way with our present system.

Mr. Africa—We do not have in use the washer referred to, but they have it in the Philadelphia gas works. I am not able to state just where it is located in the sequence of apparatus.

The Secretary—I would like to ask Mr. Africa if this naphthaline washer is on water gas or coal gas.

Mr. Africa—It is so arranged to take care of naphthaline, either from the coal gas or water gas.

The President—Mr. Morrison, would you care to say anything in regard to this?

Mr. Morrison—I think one of the chief causes of naphthaline in water gas is dirty or streaked brick in the carbureter, and the remedy would be to keep the brick clean.

Mr. Nute—The only reason I know for naphthaline in water gas is too high temperature in the superheater. The remedy of course is to reduce the heat. In fact, I have never seen naphthaline in my experience in water gas except for a short time, many years ago, when we were using naphtha, and ran the temperature too high. We got some little naphthaline in the purifying boxes; it did not get beyond that.

The President—If there is nothing further on this matter we will proceed to the next question.

"Is high pressure gas being used for industrial work instead of air blast in this country? And what are the advantages of same?"

We will postpone this, to ask Mr. Wyant if he has anything to say in regard to the question of causes of and remedies for naphthaline in water gas plants? We will give you all the time you want.

Mr. Wyant—The making of naphthaline in a water gas plant it seems to me is quite under control. The remedy is to somewhere reduce the temperature, which subjects the gas to the point of cracking up to the benzole into naphthaline and lampblack.

A Member—How about coal gas?

Mr. Wyant—That is a different matter. The only thing I know to do with naphthaline in coal gas is to wash it out.

The President—We will take up the question proposed just prior to Mr. Wyant's arrival:

"Is high pressure gas being used for industrial work instead of air blast in this country? and what are the advantages of same?"

Is anybody familiar with this matter at all?

Mr. C. A. Learned—I made a statement in my paper yesterday, that, in Birmingham, the manufacturers are using gas at 12 pounds pressure, with no air blast. My friend, who is a Meriden manufacturer, met me there, we went into his little factory, where he was manufacturing silver accessories of one kind and another. He was particularly anxious for me to see his furnace. It was a furnace, much the same as that made here by the American Gas Furnace Company, with burners set radially, so that the flame would circle around the crucible. The man lighted the furnace, the roar being very heavy, much the same, however, as with the air and gas mixed; but this was clear gas at 35 cents per 1,000, very efficient, very quick. He could melt down scrap nickel in 35 minutes. He was importing it from America, and in his process of manufacture was able to succeed very well with this kind of material. He told me the reason he did not do it in Meriden was because we charged him too much for gas. He was associated, however, with the International Silver Company, who purchase their gas at 80 cents in Meriden because they use a great many million. The process was interesting. When I went to the Birmingham gas works I saw the duplicate engine. One was running a sensitive governor, which gave a uniform 12 pounds pressure. The mains, as I stated in my paper, were cast iron, lead joint, and the meters used were of very heavy construction. The particular meter which I saw was a new Parkinson. I don't know any more about the process than what I saw there.

Mr. Wyant—If there be any interest in the type of naphthaline washer we use, I shall be very glad to describe it. The washer we are using for coal gas is a home-made affair, consisting of an old tubular condenser shell, from which the tubes were all cut out. The shell is about 6 feet 6 inches diameter, and 20 feet long, and stands on end, with gas intake at bottom, the outlet being at the top. Between the inlet and outlet it is filled with wood grids, up to a point about 2 feet from the takeoff, where there is an open space 1 foot high, with another series of wood grids 1 foot thick above this space. We introduce hot oil tar into the space near the top of the scrubber, letting it run down over the grids. At the bottom it passes out through a sealed drip and runs back to the collecting tank. As a reservoir for the oil tar, we have a large brick tank, into which the overflow from the seals in the water gas plant runs, and with it the tar from the seals and hot water gas scrubbers. We always maintain a considerable quantity of oil tar in the bottom of this brick tank. The temperature there is maintained automatically. It is very essential in naphthaline washing to maintain the temperature of the washing tar well above 100°, in order to avoid washing out the illuminants in the coal gas, and this arrangement takes care of the heating of the tar without trouble or thought. As to the quantity of tar used, it requires only ¼-horse power motor to pump a large stream, and we therefore run a large excess of this hot oil tar through the scrubber. It amounts to about 8 gallons per 1,000 feet of coal gas.

Mr. McQueston—I would like to ask Mr. Wyant if by that process he gets the napthaline out of his distribution system or just simply relieves his works. I ask this because an eminent German claims that scrubbing with water gas tar will not relieve the distribution system.

The President—Will you kindly repeat that question, Mr. McQueston?

Mr. McQueston—I would like to ask Mr. Wyant if he finds that scrubbing with water gas tar has relieved naphthaline troubles in the distribution system, or simply within the works. I ask this because lately I have seen an article by a German in which he says that scrubbing with water gas tar will relieve the works from naphthaline troubles, but will not keep it out of the distribution system.

Mr. Wyant—We have no naphthaline troubles in the distribution system at all, and I feel confident we shall not have any trouble such as you mention, from the fact that as we actually take the naphthaline out of the gas, it is not there to deposit later on. I am sorry I cannot give you from memory the quantity of naphthaline remaining in the gas after washing. We have measured the quantities before the gas passes into the scrubber and after leaving it, and only a very small proportion is left in the gas.

Mr. Kennedy—I would like to ask Mr. Wyant at what temperature the gas is when the tar strikes it.

Mr. Wyant—110°.

Mr. Kennedy—The temperature of the gas?

Mr. Wyant—Yes.

Mr. Cathels—It would be interesting to know also at what temperature the tar enters the scrubbers, and at what temperature it leaves them.

Mr. Wyant—The tar enters at about 120° and leaves at about 110°, the temperature of the incoming gas.

The Secretary—I would like to ask Mr. Wyant at what particular point in the works' sequence is the scrubber?

Mr. Wyant—The gas passes from the retort house into primary condensers, from there through the exhausters, then through an immersion washer, and from the washer through the naphthaline scrubber, then to the secondary condensers. Immediately after leaving the naphthaline washer the temperature is reduced to 70°. If we shut off the naphthaline scrubber we find it necessary to steam and wash out the secondary condensers about every 5 days. With the naphthaline scrubber in operation the necessity for cleaning the condensers is practically eliminated.

Mr. Kennedy—This is so vitally important to all of us now in decreasing water gas make, that I think it would be interesting to know something about what results those who are using the rotary scrubber, such as Mr. Barnum, I believe, and Mr. McQueston, of Lawrence, are getting. I have heard that some of those who are using the scrubbers have freed their works and deluged their system. Other men have told me that it has been just the reverse. I think it would be interesting, if it is not imposing on the time, for some of the men who are using rotary scrubbers to tell us just what they are doing. We are only starting in to experiment. As I say, last summer it was very useful to us to know a little of what some of the others had been doing.

The President—Can any member present lift this burden from Mr. Kennedy's shoulders?

Mr. Barnum—I give way to Mr. McQueston.

Mr. McQueston—We are using a rotary scrubber at Lawrence, located in a like position to Mr. Wyant's, or immediately after the tar extractor, the gas entering at a temperature around 100° F. We find it has been quite efficient, for there are now no signs of naphthaline at the works, whereas previously we had considerable trouble. I believe last fall we were troubled with naphthaline in some sections of the distribution system, but nothing very serious. Whether or not this trouble from naphthaline in the distribution system will be eliminated, after a longer period of use of the scrubber, I cannot say.

Mr. Wyant—We found that a long contact was necessary in order to absorb the naphthaline. Further, I did not mention the purpose of placing the small section of grids above the inlet of the tar. The gas, of course, is passing through the grids rapidly, and unless there be something to prevent it, the oil tar is likely to be picked up and carried away with the gas, so that it will contaminate the liquor thrown down in the condensers. We also introduce the tar as smoothly as possible, and avoid any spraying action, for the like purpose.

The President—As an adjunct to Mr. Hamilton's paper of yesterday, Mr. F. N. Speller has very kindly consented to give us some illustrations regarding the manufacture of pipe.

Mr. F. N. Speller here delivered the following lecture on

ORE TO FINISHED PIPE.[1]

Mr. Chairman and Gentlemen: Before the motion pictures are started I would like to make a few explanatory remarks. It is particularly appropriate that the gas industry, especially gas engineers, should be interested in the pipe industry, as they were responsible for the manufacturing of pipe. As near as I can find out, gas was first manufactured 100 years ago, and that necessitated for the first time a cheap pipe. A first, gun barrels were used. At the close of the Napoleonic wars these were a drug on the market. There was no other source of pipe, so hundreds of thousands of these old gun barrels were bought up cheaply, connected together by a rough-and-ready screw-joint and used quite successfully until the pipe industry was started. The first pipe was made by the same process as these gun barrel pipes were made; namely, by a crude lapweld, under the hammer, in lengths of 4 or 5 feet. There may be some here who do not understand the difference between one class of pipe and another, so I will describe briefly as we go on the elementary principles, so that when the pictures are seen you will know something of that at which you are looking. The first pipes were made by the lapweld process; that is to say, the edges of the plate were folded over roughly in the shape of pipe, so that they overlapped slightly, and the sheet in this form was placed on a mandril, while hot, and the edges hammered down tight. About 1825 the buttweld process was invented; that is, the edges of the plate were brought together, so as to butt and not lap over. This lapping was done later on by heating the flat plate in a furnace. The plates are laid parallel on the hot hearth of the furnace, and, when hot enough, the end of the plate is grasped by a pair of tongs and drawn through a die or bell, so that the edges come in contact. In this way the edges are brought together under considerable pressure. There is nothing inside of a buttweld pipe when it is being made, no mandril whatever. In the lapweld pipe, of course, they have a mandril to roll on. The lapweld process, then, consists of 2 operations: First, folding the plate over until the edges overlap, then taking the roughly formed pipe and passing it through a pair of rolls, in between which a mandril is placed, so that between the mandril on the inside and the rolls on the outside the lapped edges are pressed tightly together and forged down to the same thickness as the plate. Briefly, that is the difference between the two kinds of pipe. The buttweld pipe, of course, is the cheaper to make, and it can only be made in the smaller sizes; that is, up to about 3 inches. The lapweld process cannot be made in the smaller sizes, but can be made up to 30 inches in diameter. Lapweld pipe is made from 2 inches up, and buttweld from 3 inches down. The buttweld is about ⅔ of the strength of the pipe, and the lapweld is about ⅘ of the strength of the metal. Of course, for general purposes the buttweld pipe is plenty good enough, especially on the smaller sizes. For instance, the pressure required to burst a 1-inch buttweld pipe will be in the neighborhood of 7,000 pounds, so that the smaller the pipe the less strong the weld needs to give a very large margin of safety. [Mr. Speller then proceeded to exhibit his motion pictures, commenting as film followed film and roll followed roll.]

Discussion.

The President—I think all agree that we have had a very instructive lecture. Any questions you wish to ask Mr. Speller I think he will be willing to answer. We want to surely give him a run for his money. Will somebody please start something?

Mr. W. A. Learned—I would like to ask Mr. Speller what is Spellerized pipe.

Mr. Speller—It is a term some of the shop men started to use for lack of a better definition, and it seems to have spread round. It refers to the roll-knobbling operation. We found a difference between the iron or steel that is hammered and rolled, and we endeavor, as far as possible, in the rolling operation, to imitate what goes on in the forging. By some experimenting we finally found we could in a measure duplicate that result by using knobbled rolls. The first thing those rolls do is to break the heavy, thick scale on the surface, which is detrimental to the finished pipe when rolled in. After the first pass the scale lies loose on the surface and is blown off by means of a steam jet or high pressure water. Then the knobs on the surface, which are about ¼ inch deep, are rolled in by a flat roll, and then it receives another knobbling operation, with a smaller and different pattern of knob, and so on all the way down, until it finally finishes smooth. The idea is to put more work, and especially side work, on the surface of the plate, which leaves it more uniformly dense. It can safely be said that, as far as the metal is concerned, when worked in this way, it will not pit. There are other influences, of course, that control pitting, outside of the pipe; that is, the amount of dirt, scale, cinder, etc., with which it comes in contact. Anything is foreign to the pipe that causes a difference of potential, whatever

1. The lecture was profusely illustrated by means of motion pictures.

it is, whether scale or what not, will cause pitting. There is no way of preventing this except by keeping moisture away from the surface. But so far as the metal itself is concerned, if you clean it and put it into the ground so that it is not in contact with anything else it will corrode uniformly.

Mr. Bird—I would like to know if Spellerized pipe has a smooth surface, or if the effect of kneading the pipe is still noticeable.

Mr. Speller—No, it is not noticeable. It is finished on smooth rolls, even surface.

Mr. Miller—It was decided yesterday to carry over the discussion of Mr. Hamilton's paper. Possibly Mr. Speller will be willing to discuss it, and I would suggest that the stenographer might read some of the remarks that were made yesterday. I asked one or two questions. If he would read my remarks, for instance, it might start some discussion.

The President—Unfortunately the stenographer has not his notes here. I would ask Mr. Speller if he would say something in regard to the influence of copper on corrosion in pipe.

Mr. Speller—As far as the pipe is concerned, we have been making some tests for a couple of years on this, and are hardly ready to say just how much influence it has. It has a beneficial effect, particularly under acid conditions, and acid conditions include some atmospheric conditions. We have made and are making copper steel pipe, which can be made just as well as any other pipe under a special specification, but we have not seen enough benefit in general to warrant making all pipe of that kind of steel, because it costs about $4 a ton more, and unless you can see that benefit in nearly all the product the customer would not want to pay that. For instance, much pipe is not the subject of corrosion at all, and it would be a waste to put in an expensive alloy like that. But for special purposes, for instance, in tubes that are subject to corrosive gases in boilers, and the like, it undoubtedly adds considerable to the life of the material. I don't know that I can say much more than that. Under some conditions we find it increases the life of the pipe, treated in the way we have described, possibly 50 per cent.; in other cases the difference is not marked at all, practically the same, just depending on what your conditions are. I notice Dr. Walker, of the Massachusetts Institute Research Department, is here this morning, and he knows more about copper-steel than anybody else I know of in this country. I suggest you ask him if you are interested any further.

Mr. Miller—When Dr. Walker speaks he may answer that question in regard to the influence of silicate of iron in wrought iron tubing.

Mr. Speller—Silicate of iron is in wrought iron as an accidental impurity; it is not there intentionally, it is a part of the metal. The impurities are all rolled in and forged into the metal, and as any impurity of that kind tends to cause a longer galvanic couple, the silicate of iron and oxide of iron have that influence on wrought iron. The pitting of wrought iron is very largely caused by the percentage of impurities and the irregular way in which they are rolled in. Of course it also has the effect of retarding corrosion, rather it has an influence that way. I think that has been greatly over-estimated, though, because the cinder is in strings; it is not there in layers. It is drawn out in these strings or narrow plates, and it is very easy for the corrosion to get around or in between these strings or plates and go through the pipe. So that, although theoretically it should in a measure stop corrosion, the mechanical protection is very slight, and the accelerated effect of the cinder is very great. I hoped to have had two pieces of pipe (I sent them by post and they did not get here) illustrating the effect of this cinder on the surface of the pipe; and they were both in the same line together—the same hot water line. In one case there was no pitting whatever, in the other case the pitting was very pronounced indeed. The difference was simply due to a little heavier scale and more irregular scale in one than in the other.

The President—Is Dr. Walker in the room?

Dr. Walker—Mr. President, the Institute of Technology, has been very much interested for a number of years in this great problem of corrosion. We have watched with special pleasure the developments in the metallurgy of steel along the lines which are productive of least corrosion. The introduction of copper into steel for the purpose of making it more resistant to corrosion is, it seems to me, one of the most important steps which have been taken in the general advancement toward a more resistant product. A number of large scale tests, showing the influence of small amounts of copper in steel, have been published, and with one exception, which I will mention later, these tests have shown the addition of copper to be very beneficial. You are doubtless familiar with the very complete and careful comparison of iron and steel without copper, which was described about a year ago by Mr. D. M. Buck, in the "Journal of Industrial and Engineering Chemistry." Since the publication of this article further observation has emphasized the striking superiority of the copper bearing over the non-copper bearing metal. A few weeks ago I was in New York. When on the top of one of the big buildings, looking at the view, I noticed a lot of tie plates (there must have been 18 or 20 of them) spread out in a row, all resting on glass insulators. Having asked if some one was making a corrosion test, it appeared there was an engineer in the building who was interested in this general subject, and that he would be glad to explain the exhibit. No one would have the least difficulty in picking out from the various plates those which contained copper. The appearance when exposed to the weather is very marked. Instead of the light red, very loosely adherent scale, usually seen, the coppered steels, when exposed to the atmosphere, produce a very dark red, in fact, brown scale, of a smooth, even texture. Some of the members here doubtless attended the meeting of the Boston Society of Civil Engineer, last Tuesday evening, at the Engineers' Club, and heard Mr. Ahlbrandt, Metallurgist of the American Rolling Mill Company, describe the manufacture of the so-called ingot iron. He showed a number of lantern slides of corrosion experiments, by which he could demonstrate that the presence of copper in steel was very deleterious indeed. His position was that all steel is bad, but coppered steel is very much worse, and that the only material in which virtue lies is ingot iron. Of course, I am not here to attack steel, or ingot iron, or any other class of material. What I want to point out is that Mr. Ahlbrandt's experiments prove that there are other factors in corrosion of steel which may profoundly influence the effect which the addition of copper has. Now, I am not doubting for a minute the validity of Mr. Ahlbrandt's tests, and the fact that he has been able to make a sample of coppered steel, which will not resist corrosion as well as pure iron, demonstrates simply that there has been superimposed upon the effect of the copper the effect of some other ingredient or treatment. It is very possible that, if the steel is overheated and full of oxide, the effect of the addition of copper can be entirely neutralized by the large content of oxide present. That is, it does not follow that copper will make a highly resistant metal out of any kind of steel, however badly treated. For example, if you have a slight cold and take a good dose of bromo quinine and castor oil it will help you enormously, but if you have pneumonia and take the same thing, you may not be benefited at all. It is in my opinion the same way with steel. If you have a normal, well-made heat of steel, and introduce a small amount of copper, it will enormously increase its resistance to atmospheric corrosion; but if the steel is highly over-oxidized when the copper is added, it is possible no beneficial results will follow. While I do not know the history of the material which Mr. Ahlbrandt subjected to his test, it is very possible that due care was not taken in the manufacture of his coppered material.

The President—An opportunity is now offered for questions on this subject.

Mr. Otten—We occasionally get some pipe that has a blister extending along its length. The pipe must have been tested and found to have the proper strength. I did not know whether the pipe should be discarded, or whether, if the capacity is large enough, it would be all right to use it.

Mr. Speller—That is an abnormal condition, and if it was noticed in the mill it would be thrown out. The pipe might be all right, though. It might be properly welded. That condition used to be quite common, and is common, in wrought iron pipe, because the layers are welded together, and very often a little foreign matter is left in there, and when the heat comes on it forms a gas that results in a blister. Those blisters all originate through impurities in the metal and the formation of gases. If I might be permitted to ask a question myself, I would like to know whether any of your engineers have considered the protecting of pipe by a wrapped coating made in your own shops. I have seen some very encouraging results along that line. In fact, we are now making a pipe embalmed in this way, and we are not doing it because we want to, but because certain parties insist on having it. A plant can be put up cheaply for treating the pipe in this fashion, and it will pay for itself in very short time. That is, by "very cheaply," I mean $400, to $500 or $600. A pipe can be wrapped with muslin saturated in impervious protective coating for not over 1 cent a foot. Having a clean pipe to start with, take care to take off any rust, dirt or oil, warm it slightly (that is done by a jet of steam inside), then put on a priming coat of some-

(*Continued on page* 266.)

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NEW YORK, MONDAY, APRIL 27, 1914.

[Official.]

Thirteenth Meeting, the Wisconsin Gas Assocciation.

Wisconsin Gas Association,
Office of Secretary,
Milwaukee, Wis., April 16, 1914.

To the Members of the Wisconsin Gas Association: The Thirteenth Annual Meeting of the Wisconsin Gas Association will be held in the Hotel Pfister, Milwaukee, May 13th and 14th, 1914.

Aside from the fact that a number of interesting papers and addresses will be presented, other matters, of vital importance to the welfare of our organizalion, are in contemplation, the best and final solution of which can be arrived at only after careful and thorough consideration. The Wisconsin Electrical Association is expected to make overtures at this meeting asking consideration of the subject of combining with the Wisconsin Gas Association, and a committee, representing our organization, consisting of Messrs. W. E. Haseltine, R. B. Brown and Robert Young, has already been appointed by the President to give the matter some thought before the meeting. It is also quite probable that a request from gas men in Minnesota, to take in their territory into a joint Wisconsin and Minnesota Association, will be up for consideration.

In order to have the action of this meeting on both the subjects, as nearly as possible, representative of the unanimous sentiment of our organization, the fullest possible attendance is absolutely imperative.

Of the papers to be presented, we now have definite promise of one by Mr. Halford Erickson, of the Wisconsin Utility Commission, on "Depreciation;" one by Mr. C. R. Phenecie, of Green Bay, entitled "Some Points of Interest on High Pressure Gas Submarine Crossings;" one by Mr. D. G. Stroebel, of Ft. Atkinson, on "Equipment of Domestic Science Schools;" "Intensive Methods of Selling Water Heaters," by Mr. R. O. Jasperson, Milwaukee; "Measuring Gas in Large Quantities," by Mr. J. A. Wilson, Milwaukee; another paper, by Mr. R. C. Cornish, of Philadelphia, the subject of which has not yet been announced; a lecture, illustrated by motion pictures, showing "Modern Methods of Manufacture of Steel Pipe," by the National Tube Company; and one similarly illustrating the "Manufacture of Gas Ranges," by the Detroit Stove Works. In addition to the above other papers are still under negotiation.

Then there is the entertainment, to which the first evening of our convention will be devoted, and for the quality of which those in charge do not expect it will be necessary to make apology. Taking it all in all, the inducements are there for a record-breaking attendance; and, in anticipation thereof, I beg to remain,

Yours truly, Henry Harman, Secy.

[Official Announcement.]

Tenth Annual Meeting, Iowa District Gas Association.

Iowa District Gas Association,
Office of the Secretary,
Des Moines, Ia., April 18, 1914.

The tenth annual meeting of the Iowa District Gas Association will be held in Davenport, Ia., May 27th, 28th and 29th. The headquarters of the Association will be in the Kimball Hotel. Members are urgently requested to make early reservations. Mr. H. J. Carson, General Superintendent, Muscatine Lighting Company, is Chairman of the Committee on Arrangements, and will make reservations on request or furnish any other information desired. The following papers will be presented at the meeting:

"Circular 32 and the Report of Committee on Thermal Value and Candle Power made to the New York State Public Service Commission, Second District," by Mr. Austin Bush.
"Tar," by Mr. Alfred Hansen.
"The Storeroom," by Mr. Geo. G. Kuhn.
"Domestic Appliances," by Mr. C. W. Lockwood.
"The Elements of Gas Rate Making," by Mr. Henry I. Lea.
"Some Distribution Experiences," by Mr. W. H. Merritt.

The attention of the members of the Association is called particularly to this list of papers, which embody the most vital subjects before our industry to day. In addition, the following standing committees will report: Manufacturing, Distribution, Construction, New Business and Public Relations. One whole day of the meeting will be held on board the Mississippi river steamer, "W. W." Other interesting entertainment features are being arranged.

G. I. Vincent, Secretary.

BRIEFLY TOLD.

Obituary Note, Dudley Digges Flemming.—The subject of this obituary note will likely not be remembered or even recalled by far the greater number of the gas fraternity of to-day; but the fact nevertheless remains that for years he was one of the best known American gas engineers, and the associate, friend, and counsellor of those who ranked as the leaders of the profession. That he was not more widely known though is undoubtedly traceable to his lack of desire for prominence; indeed, of him it might be truthfully said that his leading personal trait was a desire to remain in the background. Not that he was bashful or without well-grounded beliefs and opinions, as will be conceded by those who remember the controversy over the survival of the fittest in the gas supply of Jersey City, 25 years and more ago. He was born in Jersey City, early in the year 1843, from parents of English extraction, and on both sides his ancestors were amongst the early settlers of America. On his paternal side he traces back to Governor Digges, one of the earliest Colonial Governors to receive a patent as such by the English government. On his maternal side he traced back to the Edge family, well, favorably and lengthily connected with the history of New Jersey. The branch of it from whence he sprang settled in Jersey City very early in the 19th century—the settlement was then known as Paulus Hook. In 1814 the Edge family erected the first manufacturing plant in Jersey City, in the shape of a flour mill, operated by a wind wheel. An engraving of this mill may be seen to-day on the walls of the Jersey City Free Public Library. Mr. Flemming obtained his initial tuition in Public School No. 1, Jersey City, and later on he successfully supplemented it by taking the Cooper Union (N. Y. City) Technical Course. His uncle, the late George W. Edge, who was perhaps the ranking gas engineer of his day, was then Engineer-in-Chief of the old Jersey City Gas Light Company, and Mr. Flemming in 1862 (then in his 19th year) took service with the Company, and, on the death of his uncle (January 1, 1880), succeeded him as Superintendent in the engineering administration of the plant. This he did with splendid success, and only relinquished its charge when the property came into the possession of the U. G. I. Company, in 1886 or 1887. As an engineer Mr. Flemming was a man of wonderful worth and ability, and, apart from several other inventions and varied applications of old principles to new ways and means, as an example of his accomplishments we have only to mention the Flemming regenerator furnace, many excellent examples of which are in use to-day. When the U. G. I.

people took hold in Jersey City, Mr. Flemming retired from the gas business, and devoted his later time to operating in real estate, mainly in his native State, from which pursuit he amassed a considerable fortune. Mr. Flemming is third on the chronological list of members, Society of Gas Lighting, which body he joined March 11, 1880, and yeoman's service he surely rendered it. He was its Treasurer for 17 consecutive terms, from December 10, 1896, to February 13, 1913, and also served on its Financial Committee. He was a faithful attendant at its meetings, and his faith in the Societys' usefulness never wavered for an instant. He was a member of the American Gas Light Association, which body he joined at the October meeting, 1880, but did not affiliate with the American Gas Institute, when the latter succeeded to the estates of the former. Personally, deceased was a most peculiar man, and one who first saw him might be forgiven for asking himself, "This must be a cross one!" But never a poorer estimate could be made. His broad forehead surmounted a pair of rather deep placed eyes, that shone like great beads, and seldom were his features free from frowning; but underneath it all was a heart that pulsed with blood that animated a nature that was kind in the extreme. Charitable, forgiving, fraternal, his long pathway in life was well marked with charities that were neither forced nor too finely examined as to objects. To relieve the needy was his best aim. The funeral services were held in his home, 246 Garfield avenue, Jersey City, the Reverend Dr. W. P. Brush officiating, and when the last response was made the way pointed to the old Jersey City Cemetery, where interment was made. A number of representatives of the various engineering bodies, with which deceased was affiliated, attended the services, and the Society of Gas Lighting was represented by Col. F. S. Benson, George G. Ramsdell, A. H. Strecker and Alfred E. Forstall. Mr. David R. Daly, who was also present, was a close intimate of deceased for a number of years, and if we mistake not it was in the J. H. Gautier & Co.'s shops, in Jersey City, that Mr. Flemming perfected the furnace which subsequently made his name a household word in the gas industry.

ORGANIZING THE MONTANA GAS ASSOCIATION.—On March 24th the Montana Gas Association was organized, the initial meeting having been held in the Placer Hotel, Helena, Mont. The new Association started out with a membership of 24, and with the following executive management:

President—G. A. Strain, Gen. Supt., Helena Gas Co.
First Vice-President—E. P. Pennypacker, Mgr. Butte "
Second Vice-President—A. M. Hart, Mgr., Great Falls "
Treasurer—D. C. Plank, Mgr., Missoula "
Secretary—I. C. Covert, Mgr., Billings "

Mr. A. M. Hart was also appointed Editor of the Question Box, and the next meeting will be held at Helena, Mont., February, 1915.—I. C. COVERT.

UNITED STATES SUPREME COURT REVERSES DECISION OF CALIFORNIA STATE SUPREME COURT.—A very interesting, and probably far reaching, decision has just been handed down by the U. S. Supreme Court, affecting the legal status of gas and water companies operating in California, which in turn may influence decisions in other States, in like cases. In 1870 the State Legislature enacted a law which permitted any person or corporation to occupy the streets of any town or city for the purpose of furnishing light and water, without imposing any conditions. Justice Hughes avers that the law of 1870 as enacted was, no doubt, the result of discontent on the part of the people, from abuse of privileges granted by legislatures, prior to the above date, and that the purpose was to do away with special grants, by opening the privileges to anyone who wanted to supply water and light, thus the liberal provisions became a law. In 1911 the State passed an amendment requiring all companies to take out a franchise before making any further extensions to their present systems, and the effect of such a law (if constitutional) would have been to immediately stop all work until such franchises could be obtained. Worse than all it could drive private companies out of business by refusing to grant franchises, a privilege that municipalities have under the law of 1911, thus giving them a monopoly on establishing works on municipal account. The Economic Gas Company, of Los Angeles, desiring to make a test of the matter, sent its men into the streets to continue work as usual. Thereupon its foreman was arrested for digging up the streets without a permit, as required by the new law. The case reached the State Supreme Court on habeas corpus, and was decided against the Gas Company, which in turn appealed to the U. S. Supreme Court where the case was argued in January of this year. A decision was rendered on the 6th, reversing the judgment of the California Supreme Court, which permits all companies, in existence prior to 1911, to continue to operate, and enjoy the same privileges as formerly under the old law. Companies organized since 1911 would, of course, be subject to the new law. The decision clearly sets forth that, at the time a corporation began business in a city, prior to 1911, operating as it did under the rights and privileges of the constitutional enactment of 1870, a contract ripened between the city and the corporation, the corporation agreeing to furnish its commodity, and the city, for and in consideration, agreed to allow the use of its streets. The decision comes at a very opportune time, especially in view of the charges recently made at the rate hearing of some 17 days' duration, that all Companies now operating in Los Angeles were doing so without any rights, and the claims were made such a strong part of the cheap gas arguments that the decision will no doubt seriously affect the claims and establish the rights of the companies.

CURRENT MENTION.—

THE jury in the United States District Court, Philadelphia, who heard the evidence in the case of the Welsbach Street Lighting Company against the city of Philadelphia, returned a verdict in favor of the Company for the full amount in contention—$56,563.40. Complainant contended that this sum, which was withheld in the shape of fines imposed for declared violations on street lighting account, in that contract candle power was not being maintained in certain instances, was wrongly withheld. The jury concurred in the plaintiff's presentation. The case will be appealed.

THE occupation tax paid into the city treasury of Omaha, Neb., on account of royalties over gas sold by the Omaha Gas Company during the months of January, February and March, amounted to $6,831.92.

"B. G. G.," writing from Berlin, Ont., under date of the 22d inst., says that the Ontario Municipal and Railway Board has ratified the by-law passed by the Berlin City Council to raise the sum of $67,000 to be expended by the Berlin Light Commission to increase the capacity of the gas plant. It is proposed to erect a new gasholder up to retaining 250,000 cubic feet, and to make other necessary extensions.

ACCORDING to the local newspapers of the 19th inst., 200 members of the Brooklyn Engineers' Club and the Municipal Engineers, of New York, joined in a visit the preceding day to the water gas plant of the Brooklyn Union Gas Company, on the site of the old Williamsburgh Company's works, North 11th and 12th streets, and Kent avenue and East River. This plant, was designed and constructed by and under the direction of Mr. L. S. Stiles, Engineer of Construction, Brooklyn Union Company. The party assembled at 2:30 P.M., in the office of the plant, where they were received by Mr. Stiles and Messrs. R. W. Bush (Engineer of Manufacture), C. A. Cross (Engineer, the Williamsburgh branch), E. C. Uhlig (Chief Chemist), and J. H. Braine, Engineer of Distribution. The party was divided into groups and a thorough inspection of the well-ordered, mammoth plant was made. Later on the holder station (the square bounded by North 12th and 13th streets and Wythe avenue and Berry streets) was visited. At this station two holders (each of 5 millions capacity) are maintained.

THE delays incident to the unravelling of books of accounts, some of them several years old, resulted in a putting over of the hearing before the Public Service Commission, the First New York District, in respect of the attempt of certain residents of the Woodhaven, Richmond Hill and Jamaica districts of the Brooklyn Union Gas Company, to secure an 80-cent gas rate. Col. Dykman, for the Company, asked for an adjournment until June 10th, and Robert P. Beyer, for "the people," thought May first would be about right, and the Commission decided that May 15th would be the proper thing.

THE Fitchburg (Mass.) Gas Company is proposing to extend its mains to and through the adjoining settlement of Ashby.

TRUE to the nobility of purpose shown by Ransom C. Pingree, in the prosecution of the Haverhill Gas Company, who asserted that he would not quit office until the said gas case was settled, has filed his resignation of the post of City Solicitor, to become effective the first prox. Noble man, this man Pingree. Probably the citizens could induce him to take another job.

(*Continued from page 263.*)

thing, and over that wrap it with the saturated muslin, and you have something that will keep the moisture away from the metal, and as long as you keep the moisture of the soil away from the iron you will get no corrosion. Fortunately you have only to deal with one side of the pipe. You gas engineers are particularly fortunate in that respect; you really have only half the problem that most people have to consider.

The President—Have you had any experience, Mr. Goeltz, that you can give us?

Mr. Goeltz—We have absolutely no record of increased life of pipe wrapping. We hope that we will have a little longer life from the insulation.

Mr. Speller—Does that mean that you have not had it in use long enough?

Mr. Goeltz—Not long enough to know.

Mr. Speller—I have seen some samples that had been in use 5 or 6 years compared with other pieces unwrapped, both being placed right alongside each other, in order to test it out. And the unwrapped pipe showed a very marked corrosion, while there was no action whatever on the wrapped coating. Some tests at the Bureau of Standards at Washington indicate that, so far as corrosion is concerned, the wrapping had about solved the question; at least, they say that it is the best protective coating they have yet seen.

The President—Mr. Goeltz, would you care to state the embalming process that you use?

Mr. Goeltz—We heat the pipe as described with the steam jet, and then dip it in hot asphaltum paint and cover it with paper. After wrapping, it is again dipped and wrapped, making two coats of paper, but never baked, as is done by another company.

Mr. Clark—Mr. Speller, in the National process, is that coated pipe they put out baked, or simply dipped or painted and heated—other than the steam jet, I mean.

Mr. Speller—The pipe as we make it is first cleaned and heated, then dipped, at a temperature of about 325°, into this bituminous mixture that we use, and allowed to dry; but it is not baked. The hot pipe acts, however, as a baker, you might say, and you get very much the same result; that is, you get an enamel like effect. After it is cold it is transferred to the wrapping machine.

The President—Has Mr. Gould had any experience in protecting wrought iron pipe from corrosion?

Mr. Gould—Very little. Not enough to speak about. We paint all our service pipes with red lead, and use other methods only in special cases.

On motion of Mr. Barnum a vote of thanks was given to Mr. Speller for his most interesting lecture and pictures.

The President in announcing the vote said, having extended to Mr. Speller the thanks of the Association for his very instructive lecture, he would also include Mr. Hamilton, for his work in preparing a most excellent paper on so interesting a subject.

The President then introduced Mr. G. H. Priest (Boston), who read his paper entitled,

SOME NOTES ON THE VALUATION OF MAINS AND SERVICES.[1]

Finding the valuation of street mains and service pipes requires quite a different process from that employed in determining values of visible property, instead of computations from actual measurements and depreciation of allowances made from a careful scrutiny of buildings or apparatus, results must be obtained without any actual examination of the material except at scattered intervals. For this reason much dependence must be placed upon records, and it will not be disputed, by anyone who has had experience, that accurate records of underground pipes, which have been laid for more than a comparatively few years, are sometimes missing. As the majority of gas plants in this country have been constructed for nearly 50 years, the investigator is liable to be baffled by inability to secure facts, and he must resort to every available source of information to fill in the gaps where accurate knowledge is lacking.

If the valuation of a complete distribution system is required, the gas company's records must remain the basis from which the bulk of the calculations are to be made. These may be supplemented by occasional excavations to verify plans and give opportunity for examination of soils and corrosion, and many facts of value may sometimes be obtained from the company's "Oldest employee" who "Can put his foot" (more or less accurately) "on every piece of pipe ever laid by the company." The latter information, however, will not be taken as strictly authentic by the experienced engineer.

If the gas company has kept a systematic file of working records and field books, these are likely to be much more accurate than the small scale maps or atlases on which street mains are generally plotted for office use. Having good sets of records, which cover sizes, lengths, material, joints, specials, nature of soils, depth, age, etc, it remains only to make a tabulation of the various items, apply unit prices and make an allowance for depreciation, based on actual figures. This sounds easy; but, after some days or weeks of painstaking work, the investigator may come to the end of his records, add up his totals, and find he has listed only about half of the company's underground assets, and must resort to plans and verbal information for the balance. Well-managed companies are guarding against this condition by using every effort to keep their street plans complete.

In scaling plans care must be taken to check the accuracy of the scale as well as the completeness of the drawing. If the plans are on tracing cloth, it may be advisable to use a scale of the same material, as tracing cloth will shrink and stretch to some extent with variations in relative humidity. Scalings should be frequently checked against field book records, if possible, and both should be checked by occasional field measurements of streets on which new mains of known length have been laid. In a recent appraisal of a system covering about 150 miles of mains, using the above methods, it was found that plans on tracing cloth, on a scale of 400 feet to the inch, could be scaled with an average error of less than 2 per cent., by using extreme care.

It is customary to add to the summary mains obtained by scaling maps, a certain allowance for omissions, errors due to scaling the horizontal projectione of pipes laid on steep grades, and errors due to neglecting horizontal offsets. Unless the system is laid in an unusually hilly country, it is easy to make too large an allowance for projections. The difference between the length of a pipe laid to a 10 per cent. grade, and its projection, is less than ½ of 1 per cent. A reasonable allowance should be made for omissions, and this must be a matter of judgment based on the probable accuracy of the procedure. If many of the figures have been obtained by scaling it should not be forgotten that all specials have been included, and if these are to be added as a separate item, a duplication will exist which will make up for some omissions.

The question of paving will undoubtedly start an argument. The company's records should cover the cost of all pavement cut through in process of laying pipes, and this amount is usually accepted as a proper addition to costs. Where paving has been done after the laying of mains, however, it is difficult to convince some commissions that this is a legitimate item of value, although, if an exact reproduction cost is the object, it is hard to imagine the process of installing a pipe under pavement without cutting the latter. In a large city many different kinds of paving will be encountered, and these should be noted separately, as far as possible, on account of variation in unit costs.

At this stage the investigator should find himself with a tabulated list of pipe, separated according to size and material, a summary of gate valves, roadway boxes and valve pits, drips and pipe connections, street governors and manholes, a more or less complete list of special fittings, and notes on age, depth, joint material, soil conditions, paving, etc., covering the complete system.

No matter how painstaking the analysis of quantities may have been up to this point, the time will have been wasted unless the unit values are carefully determined. Here again, the company records should be consulted. These should show the costs of both material and labor for a period of years, and while these costs are frequently incomplete, they usually constitute the only actual record of local conditions. It is seldom, however, that such costs contain anything but bare material and labor, in which case contingent and overhead expenses must be added. In a replacement valuation figures from this source will be used mainly in conjunction with others for the purpose of establishing fair unit values. Cast iron pipe fluctuates in price so frequently, and over such a wide range, that a careful average for as long a period as possible should be made. In his report to the City Council (Chicago, 1911), William J. Hagenah found that the price of pipe had varied in 10 years from $22 to $34 per ton, but that as the bulk of the pipe had been purchased when the market was low, the average price paid was about $26 for sizes 6 inches and over,

1. In prefacing the set paper, Mr. Priest remarked that he had headed his contribution, "Some Notes on the Valuation of Mains and Services," because it was in the nature of notes, and was not intended to cover the subject in extenso, but to offer some suggestions, since some may be up against the problem of finding out what mains and services are worth.

and about $27 for 4 inches. Too much care cannot be paid in computing a careful average for the locality in question, as this is one of the largest items of cost in a distribution system. Lead, cement, yarn, coke, blocking and other miscellaneous material can generally be reduced to a unit cost per joint and per foot of any given size. The cost of tools must be included, as well as material and apparatus used in unusual conditions, such as sheet piling, bracing, ditch pumps, etc. There are sure to be a number of points in every distribution system where costs have been excessive on account of unavoidable conditions of soil, weather or unforeseen interferences of a 100 different kinds. There is no accurate way to determine these unusual costs, save by actual record, rarely available, nor is there any way to escape them, and they must be reckoned with by making a liberal allowance for contingencies if insufficient data be available.

The value of paving of various kinds can usually be obtained from city hall records in case the company's records are not complete. In most localities the city does all the paving work and the cost is frequently high on this account. Labor cost will vary, of course, with localities and general conditions of business. Enough information should be at hand, covering a period of years, to separate the various classes of men, as foremen, pipe layers, caulkers, common laborers, etc., and thus derive unit labor costs for various sizes of pipe which can be applied throughout the district. Include cost of transportation of pipe and tools, men and materials, both to and from the job, also the wages of night watchmen, lighting ditches, testing, storage, etc.

The amount of rock excavation requiring blasting is an important item in some localities. The actual yardage should be determined as closely as possible, and the cost figured at the prevailing rate, which can usually be checked by consultation with local contractors.

Overhead construction expenses are bound to occur, and while these may not be as heavy as those connected with the erection of buildings and apparatus, an allowance of 15 per cent. is not excessive. Insurance, interest, taxes, engineering, supervision, damage claims, and numerous other miscellaneous expenses always follow main and service as well as plant construction, and go to make up the 15 per cent. mentioned. Contingencies, plus overhead charges, seldom total less than 25 per cent.

The total of all the foregoing expenses except overhead should be reduced to such form that they can be applied as unit costs to each size of pipe, except that the larger items, such as governors, pits, valves and unusually expensive work of a special nature, may well be kept separate. It is then simply a matter of multiplication and addition to arrive at a total value which, plus overhead charges, should represent the replacement cost new.

I might say that in using the term unit costs I have used it somewhat indiscriminately, meaning sometimes the actual costs and sometimes the unit values as applied to a system. I think the meaning will be plain wherever it occurs.

Unless the system is of comparatively recent installation, more or less depreciation is inevitable, and, if the present value is desired, this is customarily deducted from the reproduction cost. The amount to be allowed will depend very largely on the policy pursued by the company in making replacements, and in keeping records of the latter. It is much easier, apparently, to keep a record of a new main, than to subtract an abandoned main from the book assets, and care must be taken to deduct old mains which have been discontinued as worthless, but left on the street plans unless a depreciation of 100 per cent. is to be allowed on them. If replacements have been made of which no accurate account has been kept on the main records used in the appraisal work, it is obvious that the allowance for depreciation will be smaller than if such replacements had not been made, or had been properly entered on the records.

If data is available a computation should be made on the assumption of a definite annual depreciation of all sizes of pipe. The life of buried cast iron pipe is somewhat indeterminate, but if the soil is free from acid or strong alkali, cast iron pipe of good quality, and properly cast with the core centered, may be depended upon for as long a time as there is likely to be any use for it. If electrolysis has been known to occur, however, this should be carefully investigated, as it may form a considerable item of depreciation. A straight line depreciation of 1 per cent. a year is ample, if conditions are favorable. On this basis of reckoning, it is unusual for the average depreciation on a well-laid system to amount to more than 10 or 12 per cent. Cast iron pipe is much more likely to be abandoned on account of insufficient size, than because of serious corrosion. Wrought iron or steel pipe is naturally shorter lived, on account of lesser thickness of metal, and 2 per cent. or more a year is not an excessive amount to allow.

The foregoing remarks on mains apply in a general way to services as well. It is often difficult to obtain full records of the number, length and sizes of a complete system, and all the sources of information must be consulted. It is frequently necessary to take enough field measurements to establish an average length, or a number of averages to be used in streets of different widths. If the company has been in the habit of making charges for any portion of its services, these amounts should be deducted. Curb cocks and boxes should be considered as a separate item, unless they are universally used, when they may be included in the unit costs.

Unit costs should be figured with as much care for services as those used in main construction, and the same allowances should be made for contingencies, paving, overhead charges, etc. Services which are temporarily out of use should be included in the total, as they are an undoubted asset.

Most of the up-to-date companies keep their services in such a good state of repair, by means of frequent renewals, charged to operating expense, that it is questionable if any depreciation should be allowed in such cases. This must be determined by local conditions. If such a policy has not been followed, and services have been allowed to deteriorate until they naturally become worthless, depreciation figured at the rate of 3 to 5 per cent. a year will not be excessive, and, if the soil is not good, 10 per cent. may not be too much.

Discussion.

The President—This paper by Mr. Priest is a valuable addition to the library of any gas engineer. Mr. Barnum, could you start something on this subject of street mains?

Mr. Barnum—It seems to me that practically the location of the city has a great deal to do in this. In Worcester, we have a sandy soil, very dry, hence, except in cases where the service pipes are in ashes, their life is quite long. I know that in some cases considerable trouble was reported on account of the filling, and the wet soil that had to be contended with, but we have not had any special trouble with such rusting out.

Mr. Clark—Two points in this paper I want to emphasize, one of which has to do with this question of measuring up mains on plats. I found, in a series of plat books made by a county surveyor, on which the mains had been platted, the scale varied from one-twentieth to one-fourhundreth inch, and as great accuracy was necessary each plat was checked for scale or the previous sale would be transferred to the next plat. There is a great difference in shrinkage of plats, as between a blue print or a white print. This should be taken into consideration in making up an appraisal, and the average of shrinkage found by measuring in the field and checking with the different prints. The second point I want to emphasize is the fact that very few of us keep an absolutely accurate record of the cost of our gas mains and gas services. We neglect, to a very large measure, taking account of such things as cartage, storage, night watchmen, tools and small items, not large considered separately, but making up a considerable item in the aggregate. All those things go in to make up the cost of the main and service. When we make up our charges to plant for a main, we usually neglect the question of overhead expense. In the small company, where the superintendent is divided between works and street and new work, that item of cost is to a large extent forgotten. When the commission looks up your records for appraisal purposes it will take into consideration your very bare cost, as your records show, and there will be a large item, 10 to 25 per cent., that has been absolutely neglected. In this way the unit cost will be based on a prejudiced value, yet based on the very unit cost that you have yourself carried.

The President—Mr. Barnes, do you care to say anything about your cost records in Cambridge as to mains and service?

Mr. Barnes—There is nothi ng that I can say in regard to this paper except to speak in the highest praise of it. It seems to me it covers very fully all the questions likely to arise in the valuation of the street mains and services and the keeping of records. Bearing on the corrosive point spoken of by Mr. Barnum, it might interest the Association to know that, during the construction of the subway in Cambridge, we had occasion to renew a great many services and mains. One instance in particular, concerned a service pipe going into a store, of which, so far as I had any record, there never had been any complaint of service. When that pipe was uncovered we found nothing more than a streak of rust, and gas had been passing through

apparently a streak of rust. There was no service pipe to take out; the whole thing fell to pieces; crumbled right in our hands.

Mr. Priest—I would like to corroborate what Mr. Clark said in regard to the matter of incompleteness of company records. I could have elaborated on that same thing. In all the appraisal work with which I have been connected I have never yet found companies' records which showed anywhere near complete cost of installation, including overhead charges.

The President—Any further questions? Our closing time is drawing near. I will waive all formalities and extend to Mr. Priest a hearty vote of thanks from the Association for his paper.

Mr. Priest—Thank you, Mr. President.

(To be Concluded.)

Spacing of Light Units.[1]

By Thomas W. Rolph.

The degree of uniformity of illumination obtained in any lighting installation depends upon the spacing of the units. When several units are used to light an area it is desirable to arrange them in squares or rectangles nearly square. The ratio of the length of one side of the square to the height of the unit above the horizontal plane on which illumination is desired, is the important factor in determining uniformity of illumination. This ratio, usually referred to as k, is called the spacing constant. With any given installation, if the distance apart and the height are varied, so that k remains constant, the uniformity of illumination will not be affected, although the average intensity of illumination will change.

For any value of k there is a minimum photometric curve for uniform illumination. This curve will give, at that particular spacing, the highest illumination efficiency consistent with uniformity. The familiar extensive, intensive amd focusing reflectors are designed to approximate such curves, and their values of k are respectively 2, 1½ and ¼. In other words, if it is desired to mount the light-units at k=2, or the height one-half the distance apart, the most efficient curve giving uniform illumination is the extensive. As a general rule, spacing light-units closer together or higher than their correct k-value calls for, still gives uniform illumination, but decreases the efficiency. Spacing light-units farther apart or lower than their k-value calls for, increases the illumination efficiency and decreases the uniformity.

When these reflectors are used, it is a simple matter to space the units correctly, but it often happens that units giving other curves are to be used. For every light-unit there is a minimum value of k at which best uniformity is obtained, and, given the photometric curve, this value can be obtained by the method described below. It should be noted, however, that the method is applicable only to curves having not more than one general change in curvature in the lower hemisphere, such as the curves in Figs. 1 and 2.

To determine the best k-value for such curves, any slight irregularities should be eliminated, and the dotted line shown in the figures used, which are practically the same as the solid line test curves. After making this revision in the curve, is should be compared with the "critical angle curve" shown in Fig. 3, derived from the photo-

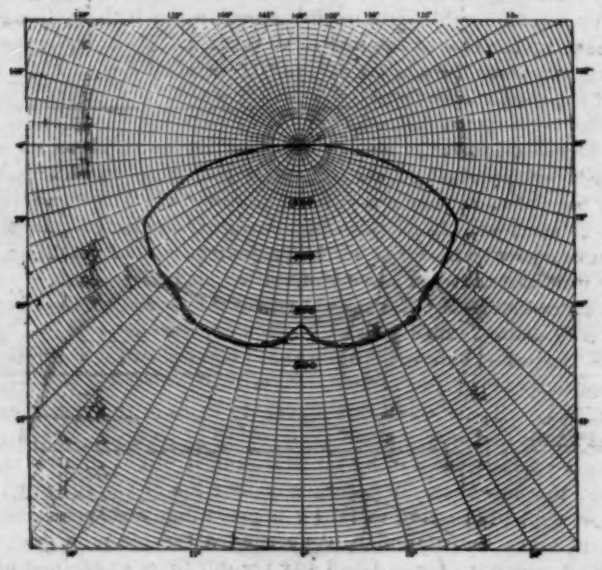


Fig. 1.

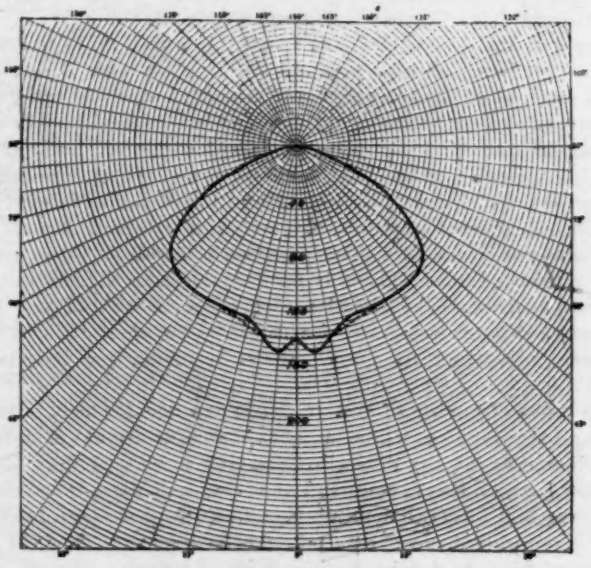


Fig. 2.

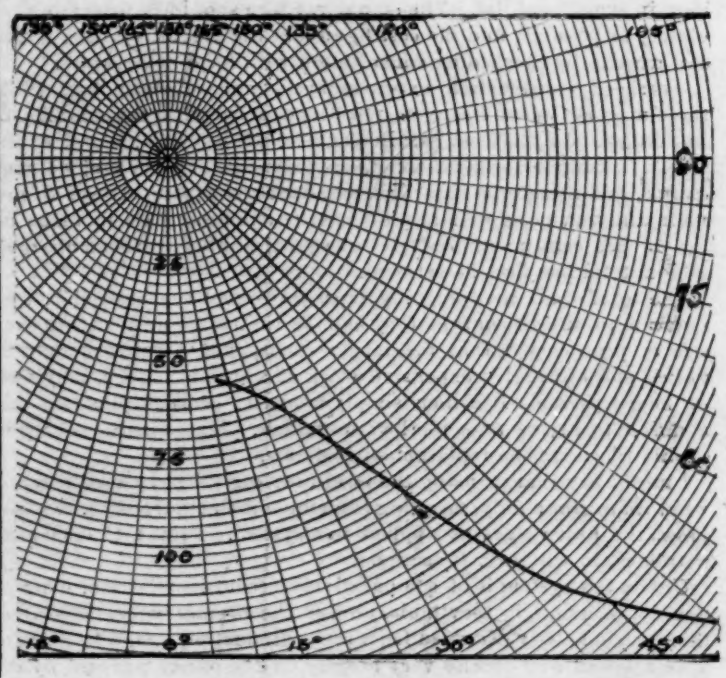


Fig. 3.

type or original extensive, intensive and focusing curves. The photometric curve (dotted line) should be plotted to the scale 100 units downward; *i. e.*, all the values increased or decreased in the proportion which will make the downward intensity 100. Comparing this curve with the critical angle curve the angle of intersection should be observed. Referring then to Table I the value of k can be obtained.

This method gives results sufficiently accurate for practical purposes, and, with a careful observance of the limitations pointed out, it may be used with confidence.

Uniform illumination is a result of correct design of the lighting appliance and its proper installation. In direct lighting, the area which can be uniformly illuminated with a certain lamp or quantity of light flux, is not dependent upon the height of suspension or the intensity upon mounting height, where reflectors of proper design are used. In this connection, the law of inverse squares—that light varies inversely as the square of the distance from its source—may be misleading and causes wrong conclusions. By use of a properly designed reflector the light flux may be so distributed that the same floor area or reference plane will be uniformly illuminated, and with the same intensity, irrespective of the mounting height.

1. "Journal of Electricity, Power and Gas."

TABLE I.

Critical Angle.	k.	Critical Angle.	k.
10 degrees	0.35	31 degrees	1.20
11 "	0.39	32 "	1.25
12 "	0.43	33 "	1.30
13 "	0.46	34 "	1.35
14 "	0.50	35 "	1.40
15 "	0.54	36 "	1.45
16 "	0.57	37 "	1.51
17 "	0.61	38 "	1.56
18 "	0.65	39 "	1.62
19 "	0.69	40 "	1.68
20 "	0.73	41 "	1.74
21 "	0.77	42 "	1.80
22 "	0.81	43 "	1.87
23 "	0.85	44 "	1.93
24 "	0.89	45 "	2.00
25 "	0.93	46 "	2.07
26 "	0.98	47 "	2.14
27 "	1.02	48 "	2.22
28 "	1.06	49 "	2.30
29 "	1.11	50 "	2.38
30 "	1.15		

Regulation of Public Service Companies in Great Britain.

[From Appendix G of the Annual Report of the Public Service Commission for the First District, New York, for the year ending December 31, 1913].

This report is the result of some six months' investigation and study by Dr. Robert H. Whitten, Statistician to the Commission, in behalf of the Department on Regulation of Municipal Utilities of the National Civic Federation. The material having served the purposes of the Federation is now published by the Commission in the hope that it may prove suggestive in the study of problems in public service regulation.

Dr. Whitten treats phases of regulation of public service companies in Great Britain that are of particular interest in connection with our own problems. He has selected for special study those phases of control that seem to offer most in the way of suggestion in the solution of American problems. His report is not, however, a mere statement of British institutions, but in the case of such important questions as the sliding scale of rates and dividends, the sale of premium shares at auction or by public tender, and the audit of public accounts, it presents a careful and discriminating discussion of the general principles underlying these methods and of their applicability to American conditions.

The sliding scale system for the automatic regulation of the rates of charge and dividends of gas companies is coming to be looked to by many as a remedy for the uncertainties and possible evil effects of our present system of occasional rate regulation, and Dr. Whitten's analysis of this important subject is the most complete that has yet appeared. He has made a particularly searching inquiry into the proper basis for the apportionment of the savings or profits between the shareholder and the consumer. He recommends certain changes in the sliding scale system as applied in England and Boston, and on the whole, considers that it has important advantages over the American system of occasional rate regulation. He, however, develops a new system of control which he calls "the merit rating method," which he recommends as superior to either of the others. Under the merit rating method the State commission "will periodically rate the companies on the basis of comparative efficiency in serving the public and allow them to earn dividends varying with such efficiency." This is a new and interesting suggestion and is worthy of most careful consideration by all who are interested in the general problem of public service control.

Public attention has recently been directed to the very large share of the profits of industry that goes to the financier, particularly in public utilities. Dr. Whitten finds that in this country the financier seems to be getting the lion's share of the profits of public utility enterprises, and that in England, on the other hand, the services of financial middleman are in large measure dispensed with through the sale of new securities at auction or by public tender. Under this method a premium stock is sold at its actual market value and the premium realized is used for betterments and additions to plants. He discussed at length the advantages and reputed disadvantages of this system of financing, and strongly recommended its adoption. In this, British experience is reinforced by the very favorable experience of the Consumers' Gas Company of Toronto.

In connection with financial manipulation and control Dr. Whitten notes the general absence among English public service companies of the holding company, and of the intertwining and interlocking of directorships, and suggests that the limited voting power of the large shareholder may be responsible for this condition. In various large public service companies there is a prescribed voting scale and no person, no matter how large his holdings, can have more than the prescribed maximum of votes (5, 10 or 30).

Effective supervision of public service companies has been promoted more by the enforcement of uniform accounting than by any other single factor. In England the practice has developed of having public service company accounts audited each year by an outside public accountant, elected either by the shareholders or by the Board of Trade. In this country the public service laws often give the State Commission authority to audit accounts, which is a valuable power, but it is recognized that it is impracticable for a commission to annually audit the accounts of all the companies within its jurisdiction, and the author suggests the advisability of requiring each company to have its accounts audited by a qualified outside accountant. The proposed model law submitted by the Department on Regulation of Interstate and Municipal Utilities makes a start in this direction by giving the commission power to require a company to have its accounts certified by a public accountant.

New Methods and Appliances.

COMBINATION FEED WATER HEATER AND OIL SEPARATOR.—One of the recognized advantages of the closed feed water heater is the fact that the water is kept entirely free from the exhaust steam, which may contain considerable oil. This type of heater prevents oil getting into the boiler, the condensed steam leaving the heater through the drip pipe, which is always open.

In some installations this condensed steam might be used to advantage, or returned to the boiler, together with drips, from a heating system or other apparatus; but the oil must be gotten rid of, and it is usually easier to take it out of the exhaust steam than to filter it from the condensation.

The special closed heater, illustrated, has a separator forming part of it, not a detached apparatus. The separator is placed at the bottom of the heater, so that the exhaust steam will impinge upon the baffles and, by change of direction and passing through the ports shown, will be freed from particles of oil without adding to the back pressure on the engine. This is accomplished by a very careful design, which is distinguished chiefly by the individual baffles and arrangement of ports having an area of 1½ times greater than that of the inlet pipe.

OIL TO PREVENT FOGS.—Georges Onofrio, a well known meteorologist, and director of the Fourviere observatory at Lyons, France, proposes to lessen or prevent fogs by the use of oil on water. A report on his experiments says: "The project consists of pouring oil on the rivers at a point where the fogs usually collect, so that the surface of the streams will be covered with a thin oil film for a distance sufficient to prevent the rise of vapors within the fog area. Experiments have been made on a small scale with a long vat, through which hot water was rapidly flowing. From the entire surface dense steam constantly rose. At about one quarter of the distance from the inlet a dividing partition was let down in the form of a double sieve holding tow moistened with oil. Following the current an oily coating extended over the lower three-quarters of the vat and immediately vapor ceased to rise. It is estimated that a coating of oil of one one-thousandth of a millimeter in thickness is sufficient to cause the disappearance of the vapor from the boiling water.

"This experiment was carried out with water at the temperature of about 185° F., so it is believed that an exceedingly thin sheet of oil

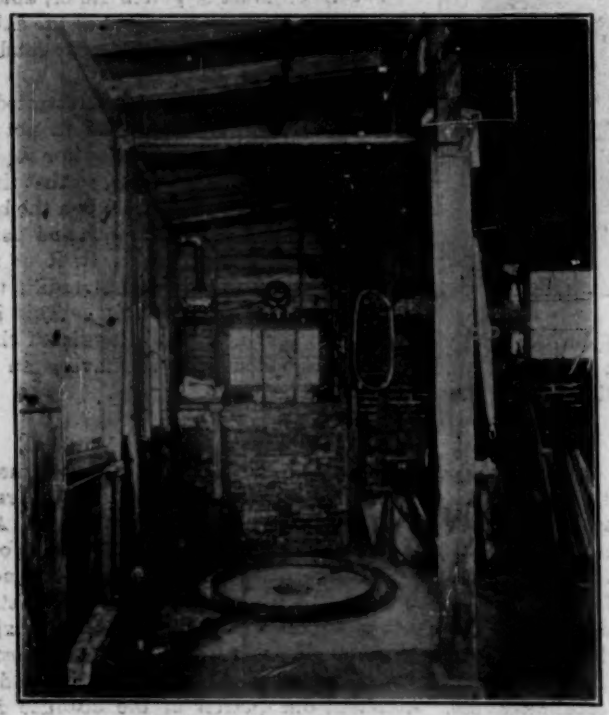
will be still more efficacious when spread over a cold surface. The thickness proposed for the rivers is one one-hundred and-fifty-thousandths of a millimeter, which will require about 0.8 gallon for every 460,000 square meters (113.67 acres).

"The oil best suited has not yet been determined. Trials are being made with animal, vegetable and mineral oils to find one that will come nearest to filling the required conditions. It must spread rapidly and easily over the surface of the water, and at the same time must have the strongest possible power of resistance and tenacity. An oil film that will readily break is of little value. These two qualities are more or less opposed and it will require some study to find the oil that will spread most easily and still not break. It is thought that an animal or vegetable oil will be found preferable to a mineral oil, though the mineral oils would probably be a good deal cheaper.

"It is not possible to give the probable cost of keeping the city free of fog until effective oil has been determined upon, although a rough estimate for both rivers puts the expenditure at $28.95 a day for the cold season. It is hoped, through the experiments now beginning, to replace the average 62 days of fog with which Lyons is annually inflicted by 62 days of normal weather."

A Noteworthy Tire-Heating Installation.—In the last issue of "New Business," Mr. Charles H. Gotwals (Norristown, Pa.), describes a tire-heating installation that will repay the close attention of vehicle blacksmiths. Mr. Gotwals remarks that all blacksmiths and wheelrights are interested in ways-and-means for heating tires, and whether that work be done through the use of wood, coal or gas, depends largely on local conditions. He then goes on to say:

"The cost of operation is the prime factor, and, when the gas rate is moderate, that fuel is certainly preferable; then, too, another point in its favor, especially in a crowdedly busy shop, is the great saving of time; in that one need not give the operation near that attention which must be directed when other fuels are used, since the maximum heat units are virtually obtainable immediately. Having tersely and pointedly declared that a great hindrance to the application of gas fuel to aid in work along this line is the high price charged for the proper heating devices to be employed, Mr. Gotwals notes that, to overcome the last objection, his company caused the construction of the below described and illustrated outfit:



To begin with, witness one 1½-horse power electric motor, 1,650 speed, and a No. 0 P. H. & F. M. Roots's Company, rotary pressure blower. From the latter is led a 2-inch pipe into a 2 inch gas line, the air line being controlled by a wheel valve, giving a quick control of the air pressure. The air and gas line is then connected by means of a union to a piece of 2-inch pipe bent into a circle, with holes drilled 2 inches apart on the inside, which circle then acts as the burner. The circles are made up in the following sizes: 40, 45, 47, 54, 56 and 60 inches diameter, which sizes are necessary on account of the varying sizes of tires. This is all placed on a concrete or brick floor, in the center of which is a pit or well of sufficient size to permit the hub to lie in, so that the wheel will rest perfectly flat. The plan of operation is to place the tire on the inside of the circle, using the ring of a dimension to leave a space of about 4 inches between the outside of the tire and the inside of the circle. In consequence, the gas flame strikes at equal distances around the whole tire and the required heat will soon be obtained. The time necessary to heat one of the largest tires sufficiently to remove it from the wheel is about 10 minutes, and to heat it again to place back on the wheel is from 25 to 30 minutes, at a cost of 15 cents per tire, including the current, with gas at $1.10 per 1,000.

Items of Interest
FROM VARIOUS LOCALITIES.

To straighten out the matter of changes in the management of the affiliated Companies of the American Gas Company, effective since January first, this list is printed: Mr. William Miller, formerly Superintendent of the Pottstown division, the Philadelphia Suburban Gas and Electric Company, was promoted to the Superintendency of the Jenkintown division, same Company. Mr. Thos. E. Spence, of Luzerne County (Pa.) Gas and Electric Company, assumed the management of the Pottstown district. Mr. H. G. Williams, formerly Manager, the Pottstown district, succeeded Mr. Wm. C. Anderson, resigned.

"With exceeding regret I inform you of the death of Dr. Allan Foster Barnes, who died, the morning of the 12th inst., in the Massachusetts General Hospital, after a brief struggle (of 3 days' duration) with acute bronchitis. Deceased, who was a son of Mr. Albert M. Barnes, President, the Cambridge (Mass.) Gas Light Company, was born in Somerville, Mass., June 27th, 1875, was prepared for college in the Cambridge Latin School, and subsequently graduated from Harvard University, Class of 1898. He then matriculated with the Harvard Medical School, graduating therefrom in 1902. Thoroughly grounded in the principles of his profession, his progress therein was really remarkable. He was on the Visiting Surgeons' Staff, the Cambridge Hospital, and in 1906 was appointed bacteriological expert, the Cambridge Board of Health. He was a valued member of the General Staff, Cambridge Hospital. He was connected with many societies, clubs and the like, possibly to the number of a score, and his personality was of the sort that makes friends and keeps them. Amongst his surviving next of kin—other than his parents—are two brothers, one of whom (Karl S. Barnes) is Assistant General Manager of the Cambridge Gas Light Company. The funeral services were held in the Chapel, Mount Auburn, the afternoon of the 16th inst.—Companion."

The Gas Machinery Company, Cleveland, O., has closed a contract with the Carolina Power and Light Company to construct for it a complete coal gas plant in Raleigh, N. C. Four arches (three to be filled with through, silica 6's, retorts each 11 feet 5½ inches in length), will be erected, complete. The installation will include a manual coke discharging machine, and the benches will be equipped with hydraulic main flushing apparatus; also, quenching bins of the McDonald-Mann type are specified. The contract further includes steam boiler plant, a 560,000 cubic feet coal gas apparatus, 3 duplex steel purifiers and connections, station meter and governor, ammonia concentrator and tar still. The work on this contract is well underway, and the construction of the benches will be commenced as soon as the foundations are ready, which will be a thing accomplished in less than a fortnight. The plant is to be ready for operation in 3 months or so.

"A most enjoyable occasion was the return visit of the bowlers of the Brockton (Mass.) Gas Light Company to the hospitalities and alleys of the Lynn (Mass.) Gas and Electric Company, which was splendidly brought off the night of the 15th inst. As a bowling tryout the session was not much thought of by the men from Brockton, 75 per cent. of the total contest going to the home talent. However, the later proceedings were all to the good. The visitors were first escorted to and through the Lynn Company's most beautiful quarters, and on the conclusion of the inspection, the party (about 85 in number) enjoyed a plentiful, well cooked, nicely served chicken supper. Mr. Eugene B. Fraser, Treasurer of the Lynn Company, welcomed the men from Brockton in a good-humored, taking sort of

speech, and the response thereto was well made for Brockton by Mr. E. B. Mooney. Of course other speeches were declaimed, all being under the toasting and roasting of Toastmaster 'Phil.'—the only 'Phil.'—Moody. Other contributors to the pleasure of the evening were 'Billy' Burke—no relative, he says, of that snappy young person whom New York made such a fuss over last winter—'Tim.' Fitzgerald, Ellsworth and Eagan, who are thinking of having a try at tenor McCormick in the way of an ordinary comparison test, and a recitation by Kane, of Brockton, that was surely well rendered. General Manager H. K. Morrison, of the Lynn Company, was very much in evidence, 'before and during' the proceedings.—T. R."

MR. JUSTIN B. BEADLEY, who is to have charge of the plants in Canisteo and Hornell, N. Y., will go in actively about June first. He will made his residence in Hornell.

MR. HANFORD C. ADAMS, General Manager, the Southern Utilities Company, died in Jacksonville, Fla., the morning of the 11th inst. His death was the sequel to a protracted attack of typhoid fever. Deceased, who was a native of Lenox, Mass., went to Jacksonville in 1910. He was in his 30th year.

THE Northern Texas Utilities Company was chartered in Austin, Tex., the 11th inst. It is capitalized in $500,000, and its avowed objects are the manufacture and sale of gas and electric currents, for light, power and manufacturing purposes; the manufacture and sale of ice, and the supplying of the public with water for municipal, power or domestic use. The incorporators are Messrs. Hiram Grossman, W. C. Woodlief and W. T. Heninger.

"B. V. T.," is informed that Mr. Charles G. Goeltz, who was on the staff of the Old Colony (Mass.) Gas Company, has been appointed Superintendent, the Chambersburg (Pa.) Gas Company, succeeding M. L. C. Cadwallader, who assumes charge at Waterville, Me.

"H. M. F.," writing from Revere, Mass., under date of the 18th inst., says: The last regular meeting of the Local Employees' Association of the Suburban Gas and Electric Company, of Revere and Winthrop, was held at the Clubhouse, the evening of the 13th. After the usual home-cooked supper had been served the regular business of the evening was taken up, and a bit later on came the "Question Box." For the social side of the evening, Mr. A. E. Bliss, General Superintendent, the Tenney Companies, gave an illustrated talk on his recent trip through Europe, which was very interesting and instructive. At the conclusion of the talk the members of the club tendered Mr. Bliss a rising vote of thanks.

THE Gault Gas Burner Company (authorized capital $115,000) has been incorporated, to transact the business of manufacturing gas burners in Louisville. The incorporators are Messrs. James B. White, S. J. C. McKenney and W. A. Rosenfield.

THE Council, Ypsilanti, Mich., recently adopted a resolution under which the sum of $75,000 was offered the owners of the franchises and plants of the Ypsilanti Gas Company. This sum is $50,000 less than the one originally agreed upon, when the question was first threshed.

AT the annual meeting, the Madison (Wis.) Gas and Electric Company, these officers were re-elected: Directors, R. B. Brown, F. W. Hoyt, John Grindle, A. E. Proudfit and C. F. Cody; President, A. P. Lathrop; Vice-President, J. Corscot; General Manager, F. L. Cross; Secretary-Treasurer, John St. John.

THE Special Commission appointed some months ago, to consider the matter of a fair price to be charged for gas in Mankato, Minn., reported to the City Council about mid-April. In fact, dual reports were submitted, by majority and minority. The former recommended a rate of $1.10 per 1,000 cubic feet, while the minority favored $1—the present rate is $1.25. Council took the matter for consideration.

MR. FREDERICK A. KINNEY, of Philadelphia, Pa., and associates, are proposing to construct a gas plant at Griffin, Ga., under the terms of the governing ordinance passed by the authorities last May. Mr. F. D. Moses, of Trenton, N. J., has been doing some preliminary work over the proposition as at present planned by the Kinney associates.

ABOUT a fortnight ago the Committee on Taxation, Massachusetts legislature, on the petition of Amos Weston, reported favoring the appointment of a commission to consider the taxation of illuminated signs used to advance commercial interests. The commission is to be composed of the following: The Chairman, Board of Gas and Electric Light Commission, Chairman the Public Service Commission, the Tax Commissioner and the Attorney General.

IN the suits of the Pacific Gas and Electric and the Natural Gas Company, against the City of Sacramento, Col., for injunctions to prevent the enforcing of a city ordinance reducing the gas rate to 95 cents per 1,000, the United States Circuit Court of Appeals, Northern District of California (Justice W. C. Van Fleet presiding), the same were referred to H. M. Wright, Standing Master-in-Chancery, to report back after taking the testimony.

ON the 15th inst. users of gas in Auburn, N. Y., were asked to notify Mayor Brister to let the Empire Gas and Electric Company know whether they wished to pay $1 per 1,000 for gas, or at the rate of 80 cents per 1,000, plus a service charge of 50 cents per month. The choice having been determined on, the rate will be kept binding, unless consent to change is given by the Company. In a statement issued this week Mr. Brister announced that, after a series of conferences with the officials of the Company, an agreement was reached whereby the consumer might avail himself of the former flat rate of $1 per 1,000.

"B. V. L.," writing from Philadelphia, Pa., under date of the 18th inst., forwards the following: "A verdict awarding to Mayor Brooks, of Elmer, N. J., the sum of $75.45 for storage due on a gas meter, which remained in his office for 3 years, will be appealed to the Salem County (N. J.) Court, by the New Jersey Gas Company, which controls several lighting companies in the vicinity. The award, which was made not long ago, after a trial before Justice of the Peace Golder and a jury, sitting in Centerton, close to Elmer, is unusual, and will be contended to a finality. About 3 years ago, prior to Brooks' election as Mayor, the Company cut off the gas from his office, but, contrary to its usual custom, did not at once remove the meter. At the end of 12 months the Company demanded the meter, and Brooks refused to deliver it until he had been paid storage charges (10 cents per day for each day the meter had remained unused on his premises). The Company refused to settle on the terms proposed, and Brooks instituted suit for a 10-cent per day rental for 1,006 days, and the jury in reaching a conclusion (the jurymen were out 1½ hours) assessed the rental at 7.5 cents per, making the total damages from their standpoint equal $75.45. The costs, too, were assessed on the Company. It may be said in this connection that the proceedings are directly traceable to a lighting contest in Elmer, in the process of which the gas was turned off and the town left in darkness for a week, or until the authorities agreed to accept the terms of a new 5-year contract for lighting the streets with gas. Brooks has been, and is, a loud yawper over the satisfaction that Elmer would have in operating a municipal electric lighting plant.

THE people of Eufaula, Ala., are congratulating themselves over the fact that their municipal gas plant was run at a profit of $69·23—the first plus shown in its history, now two years or so of record. Superintendent Skinner, however, says he'll better that report right along, and make proper allowance for depreciation, too, at that.

MR. A. A. LINDSEY, City Superintendent, the United Fuel and Gas Company, Charleston, West Va., and formerly Superintendent of the Company's plant at Huntington, West Va., has resigned to become State Agent, the Security Life Insurance Company of Chicago. Mr. W. O. Johnson, former President, the United States Natural Gas Company, is President.

IN 1913, the New York Public Service Commission, First New York District, tested 1,175 gas meters on complaint of consumers in the boroughs of Manhattan and the Bronx; an average of less than 98 meters a month. The records prove 692 of the 1,175 meters were correct, and 192 meters were "slow;" hence, 887 had the pleasure of paying for the tests. Of the Consolidated Gas Company's meters, 567 were tested. Of these 358 were correct; 114 were more than 2 per cent. slow; and 93 were over 2 per cent. fast. Two of the Consolidated meters failed to register. March first, 864,279 gas meters were in use in the Boroughs of Manhattan and the Bronx, of which 515,191 were of the Consolidated Gas Company, The Public Service Commission in March had only 69 complaints against Consolidated meters, and 50 of the meters were operating either slow or accurate.

Utilities Commission News.

AUTHORITY TO FIX RATES.—The California Railroad Commission, in granting a certificate of public convenience and necessity to the Southern California Gas Company to exercise franchise rights granted by the Board of Supervisors of Los Angeles County, directed attention to the clause in the franchise in which the Supervisors reserve the right to fix rates. Under the Public Utilities Act such a clause is inoperative, because the rates of a utility in unincorporated territory are exclusively under the jurisdiction of the Railroad Commission. A clause, stipulating conditions under which physical connections would be made to the premises of applicant for service, was suspended by the order of the Commission, being in conflict with the Public Utilities Act, giving power to the Railroad Commission to order extensions at any time.

ENCOURAGING FOR ILLINOIS.—Mr. F. H. Funk, a member of the recently created State Public Utilities Commission of Illinois, is quoted in the Chicago daily newspapers as saying that stocks that represent honest investment will be made safe by the new Commission, and honest investments will be so protected as to invite new capital into the public utility field. That the powers of the new Commission will be exercised fearlessly with the view of establishing justice between utilities and the users of the service. Rates will be reduced when the facts warrant, and increased when the facts warrant. An effort will be made to correct injustice, even at the cost of inconvenience and loss, but present inconvenience will be more than compensated for by ultimate benefits.

COMMISSION WILL NOT INTERFERE.—The Public Service Commission of Indiana will not interfere with certain electrical utilities that are operating under forms of franchises giving contractual rights. The Commission, one member declared, would hold, in these instances, that it has no power to set aside a specific contract regarding rates.

One case, that of Lafayette, has attracted much attention. The large consumers there are attempting to make a settlement of the rate issue, and it appears that an agreement will be made that will keep the case out of the Commission's jurisdiction. A decision in the Lafayette case had been written by the Commission, but, when it became known that an agreement was being considered between the company and consumers, the Commission withheld its findings.

HELP FOR FLOOD DAMAGE.—The Ohio Commission has issued a supplemental order on the application of the Dayton Power and Light Company for authority to issue preferred stock to pay part of the cost of the reconstruction of its plants and property and for the extraordinary expenditures necessary to operate its property during and subsequent to the flood of March, 1913. Upon consideration of the testimony, it appeared that the money was to be used for the payment of the partial cost of the reconstruction and the rehabilitation of service, and that these were necessary for maintenance of the service. The Commission therefore was satisfied that so much of the petition as sought its consent to the issue and disposition of preferred in the sum of $271,500 should be granted.

The Company was therefore authorized to issue this amount of stock, in addition to the amount authorized on February 17, 1914, to be sold for not less than 80. It was also ordered that upon issue of this stock the Company reduce its outstanding common stock by retiring $200,000 thereof.

TO SELL GAS BY ITS HEAT.—Under a plan proposed to the Public Utilities Commission of Kansas by H. P. Cady, Professor of Chemistry in the State University, natural gas would be sold by heat units instead of by the cubic foot.

In other words, gas bills would charge John Does with using so many million B.T.U.'s of gas in the month, instead of so many thousand cubic feet. It was represented that the heating qualities, as expressed in B.T.U.'s, varied so widely in gas from the different fields, that this is the only equitable way of selling it.

Reports showed that the heating qualities varied from 706 to 1,063 B.T.U.'s to the cubic foot; and the consumer buying the 706 brand paid as much per 1,000 feet as the one getting 1,063, though the first is worth only 70 per cent. as much for heating purposes.

J. H. McDowell of Independence, pioneer gas man in Kansas, declared to the Commission that the plan proposed was the fairest he had heard; that it would give every consumer exactly his money's worth of heat units. The plan would be to have samples of gas from every main pipe line tested every month by the State. By using these findings with the meter readings, the number of heat units each consumer received during the month would be given exactly and paid accordingly.

The proposition of R. J. Higgins, City Attorney of Kansas City, and the one suggested in the order for the hearing issued by the Commission, is that the Commission set a certain definite standard, say 800 heat units, and whenever the tests showed the gas below this to deduct that per cent. from the monthly gas bill.

The Market FOR GAS SECURITIES.

Continued dullness ruled in the city gas share market for the week, and the opening for Consolidated to day (Friday) is the lowest recorded for quite some time. The figures are: Bid, 129; offered at 130. Of course, it is readily understandable why financial conditions should be at 6's and 7's, in the light of the unfortunate state of affairs in Mexico; but, on the whole, it is difficult to really see why battles in Mexico should affect the price of gas shares in New York. The inquiry on bond account continues good. We note these recent sales:

$3,000, New York, gas, electric light, heat and power, 4's, at 96; $2,000, Brooklyn Union 5's, at 105; $2,000, California gas and electric 5's, at 93½; $3,000, New York gas, electric light, heat and power 5's, at 104½. We know that several trades were made in underlying city gas bonds, but the figures at which the trades were made are not known to us.

Brooklyn Union is dull, the nominal quotations for it being 124 to 126. In fact, the city gas share market would be nothing were it not for the local bond trading.

Peoples, of Chicago, is off 2 in the bid for the week; and Laclede common is down 3, at 92 bid. This is a very low price for Laclede, considering its interest and dividend bearing return, and Massachusetts gas, both common and preferred, are firmly held.

U. G. I. is off a point at 165, and we repeat this security offers an excellent chance for a turn that will be made this summer or early in the fall. The Kansas City situation respecting U. G. I., is not worth considering, and it really "is to laugh" when one reverts to the shrieks of certain treasury hounds (we believe some hounds are watch dogs) over the doings of the U. G. I. and its branches scattered throughout the country!

Pacific gas and electric is 32 to 38, and the regular of $1.50 quarterly on the common is payable May 15 to record holders of the 30th inst. The preferred is quoted at 81½ to 83. The American Gas and Electric of 1½, on preferred, is payable the first prox. The Am. Trust Co., Boston, Trustee for first lien 5's of the Atlantic Gas and Electric, has appointed the Chase National, of New York, and the Girard Trust, of Philadelphia, as agencies for the payment of coupons.

GAS STOCKS.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

115 BROADWAY, NEW YORK CITY.

APRIL 27.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked*
Consolidated Gas Co	$99,816,500	100	129	130
Central Union Gas Co.—				
1st 5's, due 1927, J. & J.	8.500,000	1,000	101	103
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	101	104
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	103	105
Con. 5's, due 1945, J. & J.	1,500,000	—	98	100
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	100	102
Standard	5,000,000	100	102	104
Preferred	5,000,000	100	93	94
1st Mtg. 5's, due 1930, M. & N.	1,500,000	1,000	93	95
The Brooklyn Union	15,000,000	1,000	124	124½
1st Con. 5's, due 1945, M. & N.	15,000,000	—	102	103
Yonkers	999,950	500	130	—
Out-of-Town Companies.				
Am. Gas & Electric	—	100	81	84
Preferred	—	100	48	49
Am. Light & Traction	$12,302,400	100	342	347
Preferred	14,236,308	100	105½	107½
Am. Power & Light	5,631,470	100	63	66
Preferred	3,106,800	100	80	83
Am. Public Utilities	2,995,000	100	49	51
Preferred	3,914,000	100	72½	75
Cities Service	15.7 8,700	10	90	91
Preferred	27,308,400	10	74	75
Denver Gas & Electric	7,000,000	100	92	95
Electric Bond & Share	3,500,000	100	—	—
Preferred	3.500,000	100	98½	100
Federal Light & Traction	4,750,000	100	21	23
Preferred	2,500,000	100	71	73
General Gas & Electric Co.	2,000,000	100	8	8
Preferred	1,330,000	100	55	60
Hudson County Gas Co	10,500,000	100	—	—
Laclede Gas Co., St. Louis	10,000,000	100	94	96
Preferred	2,500 000	100	—	—
Bonds	10,000,000	100	102	—
Lincoln Gas & Electric	2,2.0,000	100	30	34
Massachusetts Gas Companies, of Boston	25,000,000	100	87½	88
Preferred	25,000,000	100	91½	92
Montreal L. H. & P., Canada	2,000,000	100	220	222
Northern States Power	8,300,700	100	17	18½
Preferred	5,7 5,900	100	74½	76
Pacific Gas & Electric	38,000,000	100	38½	39
Preferred	10,000,000	100	81½	83
Peoples Gas Lt. & Coke Co., Chicago	25,000,000	100	119½	120
1st Mortgage Bonds	20,100,000	1,000	103	103½
2d " "	2,500,000	1,000	104	—
Portland Ry. Lt. & Power Co.	35,000,000	100	50	51
Standard Gas & Electric	9,343,150	100	8	8½
Preferred	11.784,950	100	24½	25½
United Gas Imp. Co.	55,502,960	50	165½	166
United Light & Railways	5,227,100	100	74	78
1st Preferred	5,000,000	100	75	77
2d "	3,000,000	100	70	72
Washington (D. C.) Gas Co.	2,603,000	20	405	410
Bonds	3,457,000	—	—	100